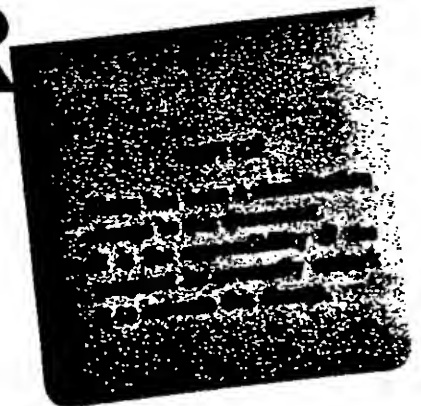
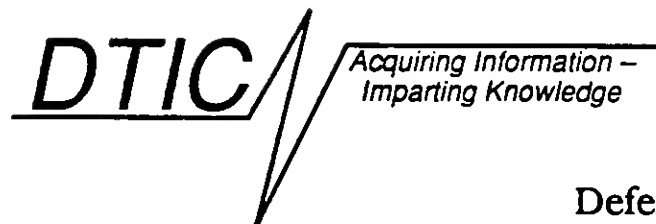


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PREFACE

This research was supported by the Advanced Research Projects Agency of the Department of Defense and was monitored by ARPA/AGILE under Contract No. SD-171.

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(U) USE OF A MARKING  
AGENT FOR IDENTIFICATION BY DOGS

by

A. C. Peters and W. H. Allton, Jr.

INTRODUCTION

One of the most provoking problems of remote area conflict is the detection and identification of enemy personnel. This problem is exemplified by the present conflict in the Republic of Vietnam, where the opposing forces are usually not distinguishable by any characteristic ethnic or racial features, identifying clothing or uniforms, language, or other appearances or actions. Obviously, the inability to identify the opposition makes almost impossible the task of controlling or countering this foe. One approach to resolving this problem lies in the development of methods for marking or labeling the enemy so that friendly forces can be distinguished from the foe. Such a concept was evolved and placed into laboratory investigation in the early 1960's.

The concept hinges around the use of a marking chemical or other material having a characteristic physical property, such as odor, which can be detected by trained dogs but will be unnoticed by human beings. The U. S. Army Natick Laboratories at Natick, Massachusetts, undertook such a program and began to search for various chemicals that would have the required properties. Squalene, an oil found in large quantities in shark and fish liver oils (as well as being a constituent of human perspiration) was selected as one suitable chemical agent. Laboratory and preliminary field studies were conducted at Fort Benning, Georgia, and the U. S. Army Natick Laboratories during 1963. The results of this investigation have been reported by U. S. Army Natick Laboratories in Report No. 7,

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"A Study of the Detection of Chemically Contaminated Persons by Dogs", dated April, 1964.

In essence, the Natick report stated that the concept was entirely feasible in that squalene appeared to be a suitable chemical agent having satisfactory chemical and physical properties. Furthermore, several dogs trained to detect the man-squalene odor performed with almost 100 percent efficiency in limited field trials conducted at the Natick Laboratories. To follow up this report, it was decided to study the feasibility of employing such a concept under simulated counterinsurgency operations and under more realistic environmental conditions.

South Vietnam was chosen as the site for conducting the subject field experiments. It presents a tropical environment, it possesses a number of terrain types, the climate is characterized by high ambient temperatures and large amounts of rainfall in a seasonal pattern, actual guerrilla warfare operations are underway in that country, and a sizable U. S. military force is present. For these reasons it was hoped that field trials conducted in the Republic of Vietnam would be most meaningful even though conducted under only simulated combat conditions.

#### SUMMARY

A field experiment was conducted in the Republic of Vietnam to study the feasibility of using dogs to detect personnel marked with squalene. Preliminary experiments demonstrated that dogs could detect Vietnamese male military personnel marked with squalene, although with a relatively low order of confidence. The suboptimum performance is attributed to the severely curtailed refresher training that could be completed prior to commencing the studies. Performance did improve

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as the experiments progressed. Dogs trained in a manner similar to the background training of these two dogs cannot be expected to satisfactorily track a squalene trail, or to seek out and locate inanimate material from a concealed or buried position.

Only very limited persistency studies were completed. However, results do indicate that squalene will persist in detectable amounts for three to four weeks in the climate of Southeast Asia when applied at a rate of about 14 pounds per acre to grassy stands of 5 to 6 feet. Furthermore, extremely sketchy data do indicate that squalene will persist on indigenous military troops for as long as two weeks when they are marked by traversing a sprayed test plot and take no specific actions to rid themselves or their clothing of the acquired squalene.

It is recommended that a new group of at least 12 dogs and handlers be trained in accordance with a detailed training program, and that the studies be repeated using test situations representative of projected operational situations.

#### MAJOR OBJECTIVES OF THE PROGRAM

The purposes of the field experiments which are the subject of this report were:

- (1) To investigate under controlled conditions the persistence of squalene when applied to selected terrain in the environment of Southeast Asia.
- (2) To investigate under controlled conditions the persistence of squalene on indigenous personnel in the environment of Southeast Asia.

In order to ascertain the capabilities and level of performance of the dogs used in the field experiments, a preliminary experiment was designed to:

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- (1) Investigate the capabilities of dogs to respond to the squalene-man scent in the environment of a south-central portion of the Republic of Vietnam.
- (2) To investigate the capabilities of the dogs to respond to materiel marked with squalene or to follow a track or trail marked with squalene in the environment described above.

The experimental plans for Phase I (Dog Capabilities) and Phase II (Persistence) are included in Appendix A of this report. Two major items were factors in designing the experimental plan for this field experiment. First, only two of the five dogs originally trained for the Natick trials were available for use in conducting the Vietnam field experiments. This, of course, placed a great deal of bias on results obtained from such a small sample. Further, the dogs were present in the Republic of Vietnam for a period of only about five weeks for conditioning prior to beginning the experiments. It was not known at that time if this would be a sufficient period for adjusting to the Southeast Asian environment.

A second major item of importance was the fact that the dogs had not been employed in active experimental use for a period of more than 18 months from the end of the Natick trials to the proposed beginning of the Vietnam trials. Therefore, a definitive knowledge of the residual capabilities of the dogs had to be determined by re-examination. As previously noted, this was the object of the Phase I experiments. For example, it was noted that the dogs had originally been trained to detect and respond to personnel who had been tagged or labeled with trace amounts of squalene. Their ability to track or trail such a marked person, or to locate items of materiel that were marked or tagged with squalene was not considered to be an inherent capability for which they had been trained.

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At least, it was necessary to determine if the dogs possessed such a capability before beginning any experiments which would require such a capability.

#### SUPPORT FOR THE FIELD EXPERIMENT

The Vietnam field experiments were conducted under the control of the Advanced Research Projects Agency (ARPA) Research and Development Field Unit, Vietnam. The experiments were a cooperative effort with the Army of the Republic of Vietnam (ARVN) and the Vietnamese Combat Development Test Center (CDTC).

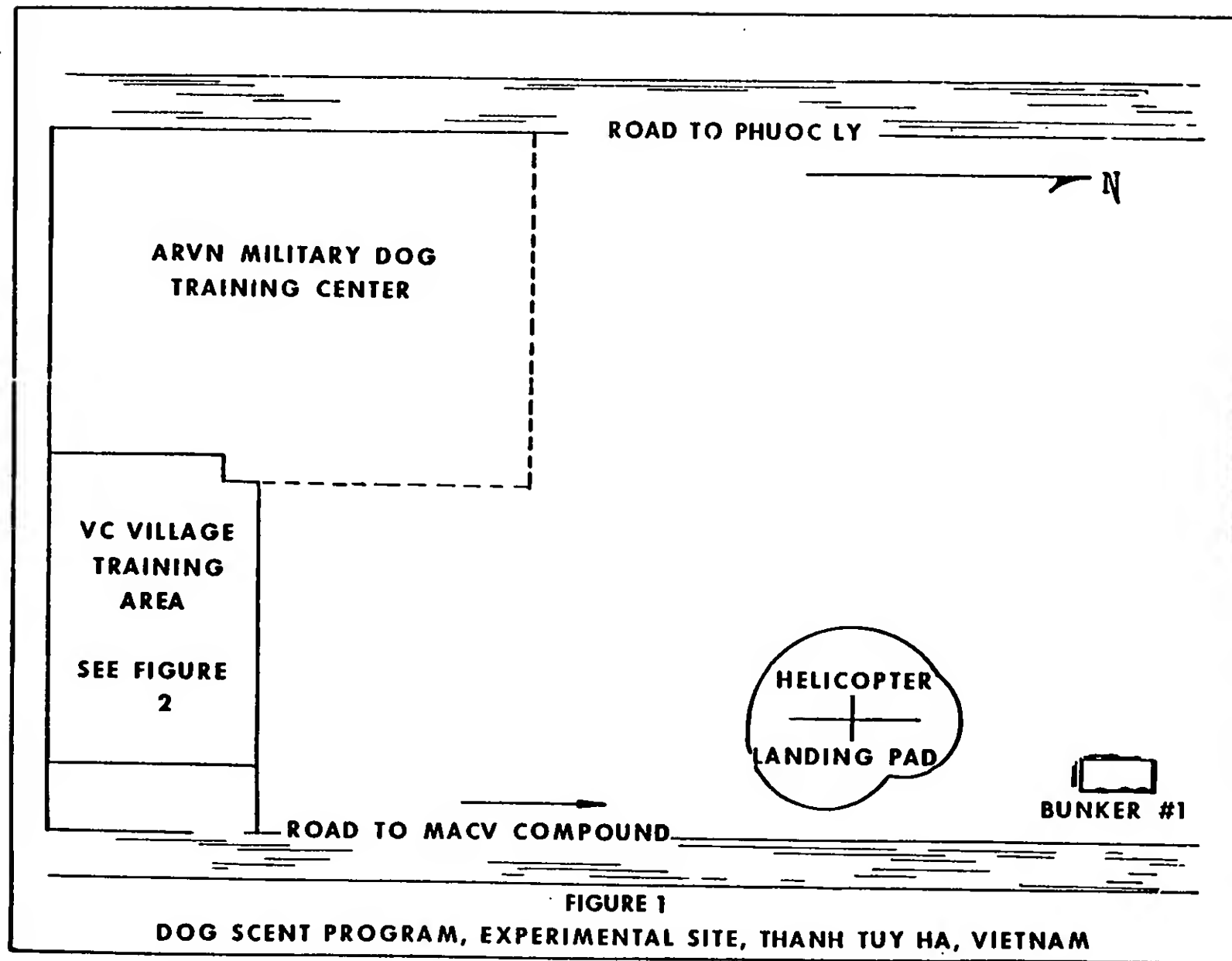
Two dogs, previously trained for squalene detection in the Natick trials, along with one dog handler, were sent TDY to Vietnam from the 26th Scout Dog Platoon, Fort Benning, Georgia. In addition, two noncommissioned officers of the U. S. Army who had extensive previous experience in handling scout dogs were attached on TDY status to the Research and Development Field Unit (RDFU-V) for assistance in conducting the field experiment. A Senior Research Scientist and a Technical Supervisor from the Columbus Laboratories of Battelle Memorial Institute were furnished to the field-experiment program to assist in designing the field-experiment plan and supervise the daily technical aspects of the experiments. The field experiments were conducted immediately adjacent to the Vietnamese Military Dog Training Center at Thanh Tuy Ha about 11 miles southeast of Saigon, Vietnam (Figures 1 and 2). In summary, every reasonable effort to provide sufficient support to these field experiments was taken.

#### PHASE I. CAPABILITIES EXPERIMENTS

The Phase I experiments were designed to be conducted during a two-day period. The protocol for the Phase I experiments is included in Appendix A of this report. However, before describing the Phase I experiments it is necessary

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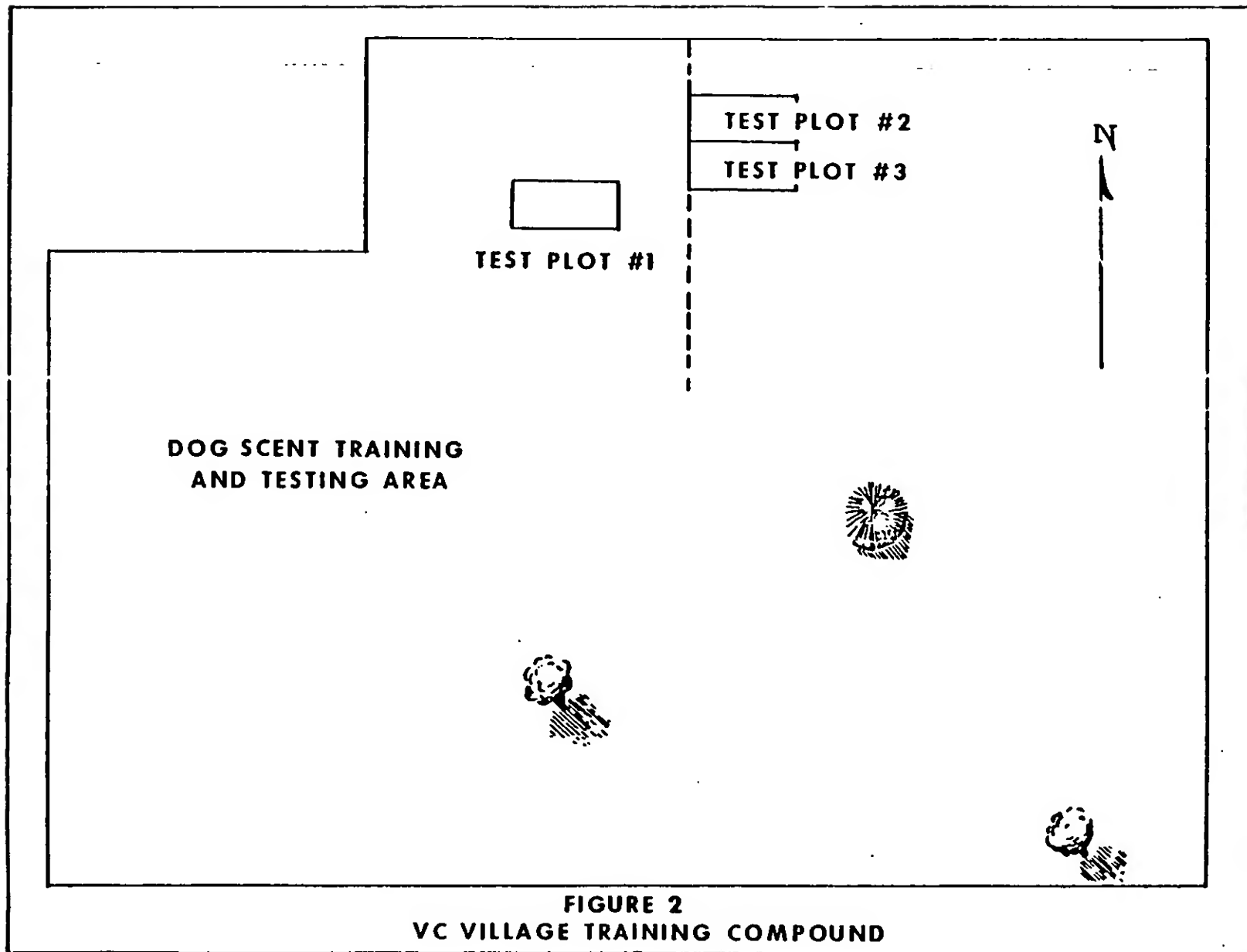


FIGURE 2  
VC VILLAGE TRAINING COMPOUND

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to review the activities which took place during the preceding two-month period since they probably had a significant bearing on the outcome of the Phase I experiments.

As previously noted, the dogs were sent to Vietnam in early August, 1965. For the next six weeks, they were kenneled at the Vietnamese Military Dog Training Center (VMDTC). During this time, they were subjected to rather mild exercise as the only form of training. No squalene was available to conduct even a limited amount of refresher training. Also, since only one handler had been sent from CONUS, Sgt. Schmidt, one of the TDY personnel, was assigned as a handler for the second dog. Rather than maintain the dogs on the standard Vietnamese military dog ration, the U. S. dogs were fed a diet of American canned dog food procured from the U. S. Military Commissary at Saigon.

Squalene became available to the field experiment on September 17. Therefore, prior to October 6, which was the first test day of the Phase I experiment, only seven days of training were available to the dogs and personnel associated with this program.

The actual field experiment was conducted during a period of three days, from October 6 to October 8. The results of this Phase I experiment have been previously summarized and reported in Memorandum No. 945 from the Chief, RDFU-V to the Director of Remote Area Conflict. During the initial lineup of unmarked personnel (Figure 3), each dog incorrectly identified at least one person in the line. Then three of nine females and three of seven males were marked with four drops of 98 percent emulsifiable squalene diluted 1:4 with water. As already indicated, one dog correctly identified one of the three marked females and incorrectly identified two males who were unmarked. The other dog correctly identified the same marked female and identified two of the three marked males.

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FIGURE 3. LINEUP IDENTIFICATION PROCEDURE USED IN DOG-SCENT PROGRAM, VC VILLAGE TRAINING COMPOUND, THANH TUY HA, VIETNAM

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However, the same dog also incorrectly identified one female and one unmarked male. When a number of marked and unmarked males were concealed in high grass at a distance of 8 to 10 feet from the dogs, the dogs were able to detect and alert to the presence of the marked personnel, but also incorrectly responded to a variable number of unmarked personnel. Similarly, when persons were in the open and marked or unmarked, the dogs gave a variable response detecting from 0 to 67 percent of the marked individuals but also responded incorrectly to up to 60 percent of the unmarked personnel. Neither dog was successful in following a trail in open grass which had been traversed some 20 to 40 minutes previously by a Vietnamese soldier whose boots were marked with squalene. This indicated no tracking capability on the part of either dog. Also, the dogs gave no alerting response when various items of materiel were displayed in the open. A daily working logbook was kept of each day's activities. Appendix B is a copy of the log recording the events of this trial of the Phase I experiment.

In summary, the dogs responded with a highly variable and rather low level of performance. This was altogether contradictory to the results reported in the Natick trials. Not only were the dogs failing to properly identify personnel who had been marked with squalene, but equally important, they had responded with similar frequency to Vietnamese personnel who had not been marked (false positive response). In evaluating the outcome of this experiment, a number of factors were considered as explanations for the sporadic behavior of the dogs as detectors.

Since squalene is a naturally occurring constituent of human perspiration, one possible explanation for the large number of false positive identifications of Vietnamese personnel by the two dogs is that this ethnic group has a naturally occurring squalene content in their perspiration which is at a level high enough to be detected by the dogs. Such an explanation would account for the large

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number of alerts on personnel who were not intentionally marked with squalene. The other major deficiency observed was the inability of the dogs to correctly detect all of the personnel who had been tagged with squalene under experimental conditions. There were two plausible explanations for this unsatisfactory performance. First, it was noted that the dogs could not work for extended periods of time during the course of a day's training or testing sessions. Particularly when ambient temperatures reached a level greater than 100 F, the dogs would perform with reasonable enthusiasm for periods of 20 to 45 minutes and then would seem to lose interest in any further detection trials. This could be a result of the dogs failing to become acclimated to the Southeast Asian environment during the period from August 3 to October 6. Another explanation for the less-than-optimum performance was that the dogs had not had sufficient refresher training in the man-squalene combination to reach a satisfactory proficiency. As already noted, the dogs had actually experienced only seven days of training with squalene prior to the beginning of the Phase I experiments after no training for at least 60 days.

In order to determine which of these factors were significant, it was decided to resume the training phase and repeat the Phase I experiments after a period of two to three weeks. During the 20 days between October 8 and October 27, six days of training and six days of simulated test training were completed. On October 28 th Phase I experiment began its second trial. During the lineup identification trials (Figure 4) in which no personnel were marked, the dogs correctly did not respond to any of the 18 Vietnamese male personnel in the test group. Six of the 18 men were then marked with squalene and the identification trials resumed. The first dog made a total of six passes down the lineup during a period of some 20 minutes and correctly identified only one of the six marked

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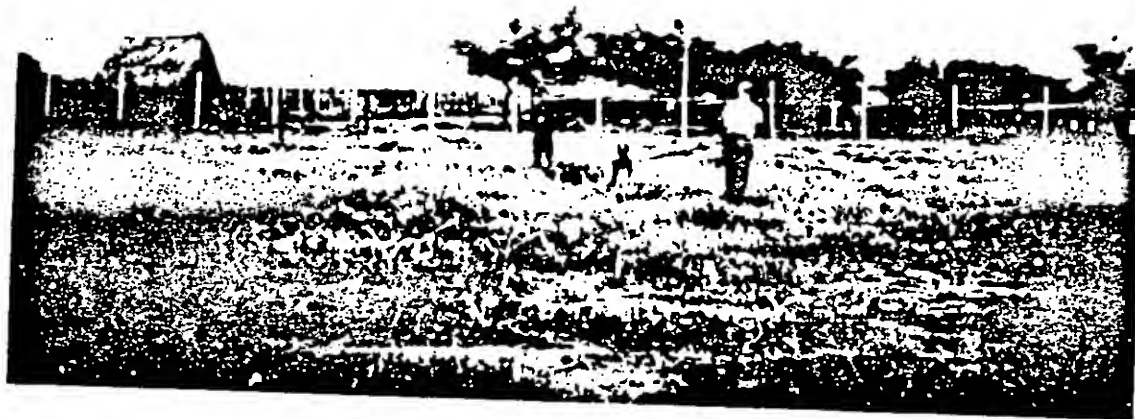


FIGURE 4. LINEUP IDENTIFICATION PROCEDURE, VC VILLAGE  
TRAINING COMPOUND

Note the marking patch attached to the  
blouse of each test subject. Controls also  
wore blank marking patches.

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men but gave no false alerts to unmarked personnel. The second dog was unable to identify any of the marked personnel during four passes. Because the wind was relatively calm, the test personnel were instructed to sit on the ground in an effort to lower the scent cone. This time the first dog was able to correctly identify one of the six marked personnel and responded with no false alerts. Lineup identification trials were resumed in the afternoon. The second dog, Benjie, in this trial made a total of six passes and did not identify any of the marked or unmarked personnel. The other dog, Buddha, then attempted the identification procedure. He also did not alert to either the marked or unmarked personnel. Three of the five marked test subjects were then inoculated with six more drops of the 1:4 squalene suspension. One dog now correctly identified two of the marked personnel, while the second dog correctly identified all five of the marked persons.

On the following day, October 29, 11 ARVN troops were all that could be made available as test subjects. Before any of the test subjects had been marked with squalene, the dogs completed an identification run and gave a positive alerting response to two of the 11 troops. Questioning of the test subjects revealed that at least four of the men had been exposed to squalene in prior training sessions and therefore would be totally unsuitable as test subjects. (As a side note, a great deal of difficulty was experienced in attempting to get proper translation of the desired experimental procedure to the Vietnamese soldiers.)

Even though the second trial of the Phase I experiment produced rather disappointing results, the results could not be definitely attributed to the failure of the experimental concept. Therefore, in a final attempt to resolve this issue, it was decided to repeat for a last time the Phase I experiments.

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During the ten-day interval between October 29 and November 7, a total of only two training sessions could be conducted. Of the eight nonworking days, two were Sundays, two were Vietnamese holidays during which Vietnamese military personnel do not work, and four days were lost for training due to the lack of availability of Vietnamese soldiers to serve as test subjects for training sessions. This was a typical sequence of activities. (See Table 1.)

The Phase I experiments were repeated for a third time beginning on November 8. A total of 19 Vietnamese army troops were available as test and control subjects. During the first lineup identification trial, in which no troops were marked, neither dog gave a false positive response. Six of the 19 test subjects were then marked as previously described (Figure 5). The first dog made a total of six passes during the 28-minute period and properly identified four of the six marked personnel. There were no false positive identifications. The second dog properly identified all six of the marked personnel and did not make any false positive identifications. This dog made a total of four passes during an 18-minute interval. The Phase I experiments were continued the following day. A total of 20 Vietnamese troops reported for the experiments; however, one of the Vietnamese soldiers had been previously exposed to squalene and therefore was eliminated from further experimental trials. On this day, the 19 test subjects, all unmarked, were lined up in a single rank. On each of two trials, neither dog made a false positive identification. In an experimental attempt to confuse the dog handlers, a third trial run in which none of the test subjects were unmarked was performed. Both dogs incorrectly made false positive identifications on two of the 19 test subjects. When informed that none of the test subjects were marked both of the handlers admitted that they may have been forcing the dogs to make an identification since they were expecting marked personnel to be among the test subjects.

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TABLE 1. DAILY ACTIVITY LOG OF MTI FIELD EXPERIMENT  
THANH TUY HA, SOUTH VIETNAM

Date	Activity
Sept. 20, 1965	Training Dogs
21	Training Dogs
22	Training Dogs
23	No Work - No Troops
24	No Work - No Troops
25	No Work - No Troops
26	No Work - Sunday
27	No Work - No Troops
28	No Work - Confucius Day
29	Training Dogs
30	No Work - Pay Day
Oct. 1, 1965	Training Dogs
2	No Work - In Saigon
3	No Work - Sunday
4	Training Dogs
5	Training Dogs
6	Test - Phase I
7	Test - Phase I
8	Test - Phase I
9	No Work - In Saigon
10	No Work - Sunday
11	No Work - In Saigon
12	Training Dogs
13	Training Dogs
14	Training Dogs
15	Training Dogs
16	No Work - In Saigon
17	No Work - Sunday
18	Training Dogs
19	Training Dogs
20	Training Dogs
21	Training Dogs
22	Training Dogs
23	No Work - Benjie has sore feet
24	No Work - Sunday
25	No Work - No Interpreter
26	Training Dogs
27	Training Dogs
28	Test - Repeat Phase I
29	No Work - No Troops
30	No Work - In Saigon
31	No Work - Sunday

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TABLE 1. (Continued)

Date	Activity
Nov. 1, 1965	No Work - ARVN Holiday
2	No Work - ARVN Holiday
3	No Work - No Troops
4	No Work - Pay Day
5	Training Dogs
6	Training Dogs
7	No Work - Sunday
8	Test - Repeat Phase I
9	Test - Repeat Phase I
10	Training Dogs
11	No Work - Veterans Day
12	Training Dogs
13	No Work - In Saigon
14	No Work - Sunday
15	Test - Phase II
16	Training Dogs
17	Training Dogs
18	Training Dogs
19	Training Dogs
20	Training Dogs
21	No Work - Sunday
22	Test - 2nd Attempt - Phase II
23	Test - Phase II
24	Test - Phase II
25	No Work - No Troops
26	Test - Phase II
27	Test - Phase II
28	No Work - Sunday
29	Test - Phase II
30	No Work - Pay Day
Dec. 1, 1965	No Work - No Troops
2	Test - Phase II
3	Test - Phase II
4	Test - Phase II
5	No Work - Sunday
6	Test - Phase II
7	Test - Phase II
8	Test - Phase II
9	Test - Phase II
10	Test - Phase II
11	Test - Phase II
12	No Work - Sunday
13	Test - Phase II
14	Test - Phase II
15	Test - Phase II
16	MTI Experiment Terminated

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FIGURE 5. LINEUP IDENTIFICATION FORMATION AT VC  
VILLAGE TRAINING COMPOUND

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When the experiments were resumed in the afternoon of November 9, only 16 of the 19 Vietnamese troops were available. Six of the 16 personnel were marked by placing four drops of a 1:4 squalene suspension on a gauze patch fastened to the right pant cuff of the test subject. One dog made four passes in 8 minutes and gave no response, either true or false positive identifications. The second dog made five passes in 10 minutes and correctly identified five of the six marked personnel with no false responses. The unsatisfactory performance of the first dog during the afternoon sessions was recognized by the handler, who remarked that the dog apparently had no interest in that afternoon's activities.

In spite of the infrequent training sessions that occurred between the first, second, and third repetitions of the Phase I field experiments, there was a marked improvement in the response of the dogs in the last trials of this Phase I experiment (see Appendix C). For the first time, the dogs and handlers appeared to have a feeling of confidence in what they were doing, and the dogs paid attention to their assigned tasks. Since the results of these last trials were markedly improved over earlier attempts to assess the dogs' capabilities, it was decided to proceed with persistence studies as described in the Phase II experimental plan.

#### PHASE II. EXPERIMENTS IN PERSISTENCE

The Phase II experimental plan was designed to assess the persistence of both the squalene on local vegetation under the environmental conditions in South Central Vietnam as well as to assess the persistence of squalene on marked personnel over a period of time. The experiment protocol is in Appendix A. After an interval of five days, during which two training sessions were completed,

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the Phase II experiments began on November 15. A test plot (Test Plot 1) measuring some 20 x 30 meters and covered with a short grass vegetation was sprayed with 800 cc of 98 percent emulsifiable squalene mixed with 8 liters of water. This resulted in a rate of application of about 7 pounds of squalene per acre. In an effort to maintain careful control and identity of the test subjects, every Vietnamese soldier employed during the Phase II experiments was carefully screened at the beginning of the day for his name and serial number in order to assure positive identification.

Sixteen Vietnamese soldiers were available for this day's experiments. It was discovered that five of the 16 men had been previously marked with squalene and had to be eliminated from further experimental procedures. Five substitute Vietnamese were made available from the Military Dog Training Center. Initially, the 16 unmarked test subjects standing in a single rank were checked by each of the two dogs in a standard lineup identification procedure. Neither dog made a false positive alert identification. The nine test subjects designated as men to be marked by traversing the course were then marched some 200 meters from the identification area to Test Plot 1 and walked along the long axis (30 meters) one time (Figure 6). Because of the short grass which covered this terrain, most of the squalene which was picked up by the personnel would have been confined to the area of their field boots, with very little coming in contact with even the bottom of their trousers.

Three of the marked men returned to the lineup area and were placed in random order with seven control subjects for lineup identification. In the subsequent lineup identification, the two dogs correctly identified the marked men on five out of six possible chances, with no false positive alerts registered by either dog.

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FIGURE 6. TEST PLOT 1

Grass and shrub 6  
to 12 inches high.

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The second group of three marked men, mixed with seven unmarked controls, were test subjects to meet the protocol objective C.2.a, a test of the persistence of squalene on personnel over a period of time when they did not launder their clothes. By this time it was 1130 hours and the ambient temperature in the sun was 115 F. As the first dog began to work by traversing the lineup identification, it became obvious that he was overheating and not paying attention to his assigned task. It was therefore necessary to suspend operations for a time.

Testing resumed at 1500 hours. It had now been some 5 hours since the marked men had traversed the test plot area. Neither dog gave a true positive alert after having completed four passes of the lineup of three marked and seven unmarked personnel. The last three marked men from the nine who had been marked in the morning were lined up with seven unmarked controls and again the dogs attempted to complete an identification. Buddha made four passes in 5 minutes and gave no alerts, either true or false. Benjie was able to correctly identify two of the three marked personnel but also falsely identified one unmarked person.

The second day, November, 16, was a cloudy hot day -- at 0930 hours it was 98 F under an overcast sky. It should be noted from reviewing the experimental protocol for the Phase II experiments that many studies included in the experiment required the periodic return of certain marked personnel in order to determine persistence on individuals over a time span. Having requested the return of the nine marked men on November 16, we were informed that all nine of the men had been transferred to a new battalion at another location. Therefore, no measure of persistence on individuals could be gained and the experiment had to be started again. By this time, it was also becoming apparent that increased Viet Cong activities in the immediate neighborhood of the Military Dog Training Center would impose a serious problem in availability of Vietnamese troops for test subjects.

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Fifteen new, unmarked Vietnamese troops were procured to begin again the Phase II persistence studies. Three of the men were walked through the test plot which had been sprayed 24 hours previously. They were then placed in random order in a line with 12 unmarked personnel. Each of the dogs was able to identify only one of the three marked personnel (the same marked man by both dogs). The test subjects were reshuffled in a new random order and the dogs again attempted identification. Neither dog was able to correctly identify any of the three marked personnel from among 12 control personnel. A repeated trial 48 hours after squalene had been applied to Test Plot 1 indicated only partial ability by the dogs to correctly identify marked personnel. Test Plot 1 persistence data are summarized in Table 2. Since only one of the two dogs was now working satisfactorily, the results were equivocal. However, it was an indication that the squalene persisted for as long as 48 hours on this type of terrain at 7 pounds per acre.

During the afternoon of November 17, a second test plot measuring about 20 x 30 meters was sprayed with squalene at a rate equivalent to 14 pounds per acre. This plot also differed from the first test plot in that it contained grass, shrubs, and bushes varying from 2 to 5 feet in height. Therefore, there was double the concentration of squalene applied to the test plot as well as a higher and denser vegetation (Figure 7). The following morning, November 18, 13 fresh troops from a different military district were made available as test subjects.

Three men traversed the 30-meter length of Test Plot 2, which had been sprayed some 18 hours previously, and lined up with ten unmarked controls. One dog made no alerts during six passes, while the second dog correctly picked out all three of the marked men in four passes, with no false alerts. The first dog

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TABLE 2. PERSISTENCE OF SQUALENE ON VEGETATION - TEST PLOT 1

Squalene applied by hand sprayer on November 15, 1965,  
at a rate of 7 pounds per acre.

Date	Days After Application	No. of Marked Test Subjects	No. of Controls	True Alerts		False Alerts	
				Buddha	Benjie	Buddha	Benjie
11/15/65	0-1 hr	9	21	2/9 <sup>(a)</sup>	5/9	None	1/21 <sup>(b)</sup>
11/16/65	1	3	12	1/3	1/3	None	1/12
11/17/65	2	3	9	0/3	2/3	None	1/9

(a) Indicates 2 of the 9 marked test subjects were correctly identified.

(b) Indicates 1 of 21 unmarked controls was incorrectly identified.

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FIGURE 7. TEST PLOT 2

Grass, shrubs, and bushes,  
2 to 5 feet high.

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was then returned for lineup identification and proceeded to correctly identify the three marked men in three rapid passes, with no false alerts. The three marked men were then reshuffled in random order with the ten unmarked controls and the dogs again attempted to identify the marked personnel. One dog correctly identified the three marked men in four passes with no false alerts. However, the second dog only correctly identified two of the marked men in two passes; the handler remarked the dog was losing interest because of the heat. Though it was only 1030 hours, the ambient temperature in the sun was now in excess of 120 F. The trial was repeated one more time that morning with the marked personnel in a new random order among the ten unmarked control troops. Each dog was able to correctly identify all three of the marked personnel. Because of the heat, further testing was suspended for the day.

The following day, 14 test subjects were available; only one of them had walked through Test Plot 2 the previous day. One of the remaining men also had traversed Test Plot 1 four days previously. One dog attempted four passes for identification but simply was not in a working mood. The second dog correctly identified the man traversing Test Plot 2 the previous day but did not identify the man traversing Test Plot 1 four days previously. This was a subtle indication that persistence on the individual under conditions of Test Plot 1 may be expected for two days but may not be present as long as four days. Three of the 12 unmarked groups were then marched through Test Plot 2. All three of the marked men were correctly identified by each of the dogs when standing in random order among the remaining nine unmarked controls. These results indicated there is a good two-day persistence under conditions of terrain and application described for Test Plot 2. Even though the ambient temperature was in excess of 120 F, men marked two and four days previously were repeated in lineup identification with unmarked controls. Again,

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the dogs was able to identify the men who had been marked two days previously but was unable to identify the man who had been marked four days previously by traversing Test Plot 1. The following day, two of the men marked on the previous day from Test Plot 2 returned for identification. However the day's work was very seriously handicapped because only one of the dogs was available for identification purposes, and he was working with less than total efficiency. The single dog was able to correctly identify individuals who had been exposed to Test Plot 2 two days previously, as well as to correctly identify two men who had just walked through Test Plot 2 three days after its application. Since these troops were from a different military district, they now had to return to their original site of assignment, and once again the persistence trials were abruptly terminated before satisfying even a small portion of the total proposed experimental plan. A third test plot (Figure 8), almost identical with Test Plot 2 was sprayed on November, 22. All persistence data are summarized in Tables 3 through 6.

Beginning on November 22, conditions steadily deteriorated until finally the field experiment was terminated on December 15. During much of this time, only one dog was available for the experiments because of injury to the handler of the second dog. Finally, in an attempt to use both dogs a new handler, Sgt. Robert Bennett, was assigned to the second dog. Also, there was no consistency to the availability or returning requirement for Vietnamese troops. Increased military operations and alerts in the vicinity of the Military Dog Training Center due to rising Viet Cong activity precluded Vietnamese troops being available as test subjects during the normal working day. It soon became necessary to go out to surrounding bunker positions and actually round up troops on personal

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FIGURE 8. THREE VIETNAMESE SOLDIERS WALKING THROUGH TEST  
PLOT 3, VC VILLAGE TRAINING COMPOUND

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FIGURE 8. THREE VIETNAMESE SOLDIERS WALKING THROUGH TEST  
PLOT 3, VC VILLAGE TRAINING COMPOUND

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TABLE 3. PERSISTENCE OF SQUALENE ON VEGETATION - TEST PLOT 2

Squalene applied by hand sprayer on November 17, 1965,  
at a rate of 14 pounds per acre.

Date	Days After Application	No. of Marked Test Subjects	No. of Controls	True Alerts		False Alerts	
				Buddha	Benjie	Buddha	Benjie
11/19/65	2	3	9	3/3 <sup>(a)</sup>	3/3	1/9 <sup>(b)</sup>	1/9
11/20/65	3	2	6	2/2	-- <sup>(c)</sup>	1/6	-- <sup>(c)</sup>
11/23/65	6	3	6	2/3	-- <sup>(c)</sup>	1/6	-- <sup>(c)</sup>
11/27/65	10	2	3	2/2	2/2	None	None
11/29/65	12	2	3	2/2	2/2	None	None
12/2/65	15	2	4	2/2	2/2	None	None
12/4/65	17	2	None <sup>(d)</sup>	2/2	2/2	--	--
12/8/65	21	2	2	1/2	2/2	None	None
12/9/65	22	2	None <sup>(d)</sup>	2/2	2/2	--	--
12/10/65	23	2	None <sup>(d)</sup>	2/2	2/2	--	--
12/11/65	24	2	None <sup>(d)</sup>	-- <sup>(c)</sup>	2/2	--	--
12/14/65	27	3	3	2/3	3/3	2/3	None
12/15/65	28	1	None <sup>(d)</sup>	1/1	1/1	--	--

(a) 3/3 indicates all three of the three marked test subjects were correctly identified.

(b) 1/9 indicates one of nine control subjects was incorrectly identified.

(c) Dog not working on day shown.

(d) When controls were unavailable, additional test subjects (those who had walked through test plots on previous dates) were used in the lineup.

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TABLE 5. PERSISTENCE OF SQUALENE ON MARKED INDIVIDUALS - TEST PLOT 2

Test Plot Age (Days) at Exposure	No. of Test Subjects Exposed	No. of Test Subjects Returning Indicated No. of Days After Exposure		No. of Test Subjects Correctly Identified	
		Days	No. of Subjects	Buddha	Benjie
1	3	1	2	2/2	--(a)
		6	1	0/1	--(a)
		9	1	1/1	0/1
		12	1	1/1	0/1
		13	1	0/1	1/1
		14	1	0/1	0/1
		16	1	1/1	0/1
		17	1	1/1	0/1
		18	1	1/1	0/1
		20	1	1/1	0/1
		24	1	1/1	0/1
		26	1	1/1	0/1
		2	2	0/2	--(a)
		9	1	0/1	0/1
6	3	1	1	1/1	1/1
		4	1	0/1	1/1
		5	1	1/1	1/1
		6	1	0/1	1/1
		8	1	1/1	1/1
		9	1	1/1	1/1
		10	1	0/1	1/1
		12	1	1/1	1/1
		6	1	0/1	0/1
		7	1	0/1	0/1
10	2	9	1	0/1	0/1
		10	1	1/1	0/1
		11	1	0/1	0/1
		13	1	1/1	0/1
		14	1	0/1	0/1
12	2	6	1	0/1	0/1
		7	1	0/1	0/1
		9	1	0/1	0/1
		10	1	1/1	0/1
		11	1	0/1	0/1
		13	1	1/1	0/1
		14	1	0/1	0/1

TABLE 4. PERSISTENCE OF SQUALENE ON VEGETATION - TEST PLOT 3

Squalene applied by hand sprayer on November 22, 1965,  
at a rate of 14 pounds per acre.

Date	Days After Application	No. of Marked Test Subjects	No. of Controls	True Alerts		False Alerts	
				Buddha	Benjie	Buddha	Benjie
11/22/65	0-1 hr	9	14	6/9(a)	--(b)	None	--
11/23/65	11	3	9	3/3	--(b)	None	--
11/24/65	2	2	2	2/2	--(b)	None	--
11/26/65	4	2	4	2/2	--(b)	None	--
12/6/65	14	2	1	2/2	1/2	1/1(c)	1/1
12/7/65	15	2	1(d)	2/2	2/2	None	None
12/13/65	21	1	None(d)	1/1	1/1	--	--

(a) 6/9 indicates 6 of the 9 marked test subjects were correctly identified.

(b) Dog not working on day shown.

(c) 1/1 indicates that the one unmarked control present in the lineup was incorrectly identified.

(d) When controls were unavailable, additional test subjects (those who had walked through test plots on previous dates) were used in the lineup.

TABLE 5. (Continued)

Test Plot Age (Days) at Exposure	No. of Test Subjects Exposed	No. of Test Subjects Returning Indicated No. of Days After Exposure		No. of Test Subjects Correctly Identified	
		Days	No. of Subjects	Buddha	Benjie
12	2	15	2	0/2	0/2
17	2	1	1	0/1	0/1
		2	2	0/2	0/2
		3	1	0/1	0/1
		4	2	0/2	0/2
		6	1	0/1	0/1
		8	1	1/1	0/1
		10	1	0/1	0/1
21	2	1	2	0/2	1/2
		4	1	0/1	0/1
		5	1	0/1	0/1
		6	1	0/1	0/1
22	2	1	1	1/1	0/1
		5	1	0/1	0/1
24	2	2	1	0/1	0/1
27	3	1	1	1/1	1/1

(a) Dog not working on day shown.

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TABLE 6. PERSISTENCE OF SQUALENE ON MARKED INDIVIDUALS - TEST PLOT 3

Test Plot Age (Days) at Exposure	No. of Test Subjects Exposed	No. of Test Subjects Returning Indicated No. of Days After Exposure		No. of Test Subjects Correctly Identified	
		Days	No. of Subjects	Buddha	Benjie
0-1 hr	9	1	3	1/3	--(a)
		2	1	0/1	0/1
		3	1	1/1	--(a)
		4	2	0/2	0/2
		6	2	1/2	0/2
		9	1	0/1	0/1
		10	2	1/2	1/2
		11	2	0/2	1/2
		13	1	1/1	1/1
		14	3	2/3	1/3
		15	2	1/2	1/2
		16	1	0/1	0/1
		17	1	1/1	0/1
		21	1	1/1	1/1
		1	1	1/1	--(a)
		2	2	1/2	--(a)
		5	2	0/2	0/2
1	3	10	1	0/1	0/1
		13	1	1/1	0/1
		14	1	0/1	0/1
		15	1	0/1	1/1
		19	1	1/1	1/1
		21	1	1/1	1/1
		2	2	0/2	1/2
		4	1	0/1	0/1
		8	1	0/1	0/1
		9	1	0/1	0/1
2	2	11	1	0/1	0/1
		12	1	1/1	0/1

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TABLE 6. (Continued)

Test Plot Age (Days) at Exposure	No. of Test Subjects Exposed	No. of Test Subjects Returning Indicated No. of Days After Exposure		No. of Test Subjects Correctly Identified	
		Days	No. of Subjects	Buddha	Benjie
2	2	13	1	1/1	1/1
		18	1	1/1	1/1
		20	1	1/1	0/1
4	2	5	1	0/1	0/1
		6	1	0/1	0/1
		9	1	1/1	0/1
14	2	1	1	0/1	0/1
		3	1	0/1	0/1
15	2	1	1	0/1	0/1
		3	1	0/1	0/1
		5	1	0/1	0/1
		7	1	0/1	0/1

(a) Dog not working on day shown.

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initiative. Therefore, many of the data on persistence were procured on a hit-and-miss basis, and are subject to guarded interpretation. On some days, there were so few troops available that no men could be assigned as controls; all available men were marked as test subjects.

#### DISCUSSION

Significant effort was devoted at the outset of this field experiment to the design of a sound research plan which would give objective data to properly answer the questions posed as the objectives of the Vietnam field experiment. However, it became apparent very early in the experimental phase of this research program that close adherence to the research protocols for the field experiments would not be possible; it was necessary to make do with what was available. Every effort was made, however, to secure enough objective information to make possible a valid judgment of the feasibility of the concept.

It should be mentioned here that Sgt. Robert Bennett, one of the original dog trainers at the inception of the Natick experimental program was present during all of the Vietnam field trials to render knowledgeable, experienced observations. Sgt. Bennett returned to the U. S. and spent from January 19 through 21, 1966, at the Columbus Laboratories of Battelle in extensive debriefing sessions. Much credit is due Sgt. Bennett for his contribution to this research program and report.

The first action of the Vietnam experiment was to identify the capabilities of the two dogs to be used as the detection device for this marking concept. The initial trials of the dogs in the Phase I experiment clearly demonstrated that they had not been trained for and did not possess a capability for either locating and identifying marked materiel or for following a trail or track produced by a

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marked person. Furthermore, their capability in identification of marked personnel was at a very low state of efficiency. Prior to this initial experiment, it was conjectured by some that the dogs were capable of locating and seeking out anything and everything which had been marked with even the slightest trace of squalene. This misconception probably resulted from the misinterpretation of a possibly ambiguous statement in the Natick report. This statement seemed to indicate that the dogs were capable of tracking any person who had been marked with squalene. Detailed review of the report disclosed, however, that the dogs were in fact trained only for one type of identification mission: the identification of men wearing military uniforms which had been marked with trace amounts of squalene.

While the Phase II plan was adequate to demonstrate the objective sought for in that experiment, it proved to be too complex to be satisfactorily conducted under collaborative conditions at a remote site in a foreign nation. The Vietnamese military unit supporting the experiments by furnishing troops as test subjects was also engaged in actual military activities against enemy forces. This was a major obstacle to the total effort. A lesson to be learned from this program is that it is impossible to conduct an experiment unless the experimental subjects are under the direct control of the group conducting the experiment.

Undoubtedly, the most important single factor responsible for the suboptimum results obtained in the experimental program was the very low level of training of the two dogs. Only one handler who had had immediate previous experience working with the dogs was available at the outset of the program. A second handler was assigned and given only a few weeks to retrain his dog for optimum performance. The dogs had been subject to only very limited squalene training prior to their arrival in Vietnam, and it had been 20 months or more since the dogs had participated in experimental sessions. Moreover, they had to remain in kennels without training for six weeks after their arrival in Vietnam because the squalene was not available. During

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the 87 days that the field experiments were under way, only 27 days of training and 25 days of simulated tests or test conditions occurred. This means that of the 87 days available for the experiment, no work at all was accomplished on 35 days, or 40 percent of the time. Contrast this with the intensive training given the dogs prior to the Natick experiments in which 100 percent efficiency was obtained. The dogs participating in the Natick program were subjected to three weeks of intensive daily training in identification procedures (sessions which lasted all day long every day). The initial three weeks of intensive training were followed by another 18 to 20 weeks of daily intensive training in identification and scout-type problems using carefully controlled test subjects and situations (see Appendix D).

Another factor which influenced the test results was the use of female test subjects. During the first Phase I experiments, groups of female soldiers from the Army of the Republic of Vietnam were used on several occasions as test subjects. The dogs were unable to identify most of these subjects who had been marked with squalene. This is not surprising, since this was the first time the dogs had been exposed to female test subjects as part of their working schedule. It is quite likely that there is a different odor relationship between men and squalene and women and squalene, regardless of the ethnic origin of the population considered. This does not necessarily mean that the dogs cannot distinguish females marked with squalene. Rather, it indicates that since they had not been trained for such detection, they did not respond automatically to females marked with squalene.

It was initially planned that the persistence trials would be conducted during the latter portion of the rainy season and repeated during the early portion of the dry season in an effort to determine the influence of rainfall on

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the persistence of squalene on vegetation. Because of the delays experienced during the Phase I experiments, the Phase II persistence studies could not be initiated until mid-November, supposedly the end of the rainy season. However, a review of the meteorological data presented in Appendix E shows that while November was characteristically a drier month than the previous month of October, rainfall approaching the levels of October was experienced in December. Also, a review of daily temperature recordings indicates that there was some elevation of temperature toward the end of the experimental period, but the increase does not appear to be significant.

Another limitation to the experimental program as it evolved was the restriction of test sites to areas that could be considered secure from Viet Cong military activity. This meant that only one type of terrain could be assessed for persistence. The major portion of South Vietnam lying to the south of the capital city of Saigon is rice-paddy terrain, and no persistence studies were attempted in rice-paddy areas.

In all cases, squalene was applied to test-plot sites with a hand sprayer rather than by such means as airplane or helicopter. This was another limiting factor.

While all of these factors detracted from the ability to conduct a complete and detailed field experiment which was designed to generate quantitative objective data, the persistent efforts of the personnel assigned to conducting the experiments did allow the gathering of enough information to render some valid judgments on the feasibility of the concept of marking and identification of human personnel with squalene.

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CONCLUSIONS

This field experiment was conceived and planned to demonstrate conclusively the feasibility of using the squalene marking system in tactical counter-insurgency operations under conditions such as exist in Vietnam. Experiment protocols (Appendix A) were written to produce data in sufficient quantity as to be amenable to statistical analysis if desired. However, an examination of the tables of results of persistence studies, for example, quickly reveals that only a small portion of the planned program was, in fact, completed. For reasons previously noted, it was a question of doing each day what could be done with the resources available. In spite of the obstacles, it is believed that the following conclusions can be inferred from the data available and are, within limits, valid.

- (1) Suitably trained dogs can detect the man-squalene scent in the environment of Southeast Asia exemplified by the Republic of Vietnam.
- (2) These particular dogs were virtually unresponsive to either materiel marked with squalene or to trailing personnel leaving a squalene track. However, there were indications that it would be reasonably easy to train dogs specifically for such missions.
- (3) Under the environmental conditions recorded elsewhere in this report, squalene is sufficiently stable to persist on vegetation in quantities sufficient for marking purposes for periods of up to three to four weeks. Experiments could not be completed to determine if this time interval could be reduced or increased by varying the rate of application to the ground cover.

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- (4) There is an indication that personnel marked in the described fashion will continue to carry detectable levels of squalene for periods of at least two weeks. This conclusion is very guarded because of the very meager supporting data.
- (5) Dogs used in such a detection concept must be maintained in a constant state of readiness through continuous and vigorous training if they are to be reliable; the two dogs in this study were more effective in the last stages of the project, when they worked on almost a daily basis. Furthermore, the dogs must be well conditioned to withstand the rigors of working in a tropical environment.
- (6) Each dog handler must work constantly with his individual dog for a number of weeks before he can properly interpret the response of his dog to the man-squalene scent. The performance of the dogs used in this program was markedly decreased after several days of inactivity, and when dog handlers were changed during Phase II of the experiments.
- (7) When using indigenous personnel as test subjects in field experiments in a foreign nation, it is essential that such personnel be under the direct control of the group conducting the study and that a proficient interpreter be made available full time to the group. In spite of prior coordination through command channels, detailed written and verbal instructions, and close cooperation with local unit commanders, it was impossible to conduct the preplanned field experiments because of insufficient numbers of test and control personnel made available. The requirement for a proficient interpreter cannot be overemphasized.

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#### RECOMMENDATIONS

Despite the somewhat disappointing results obtained in the recently completed Vietnam field experiment, the concept of using squalene as a marking agent for personnel, with subsequent detection and identification by trained dogs, would still appear to be a valid and useful concept. Therefore, it is recommended that the concept development should continue. Hopefully, future development could profit by eliminating or minimizing the pitfalls experienced in this study. Immediately, the next steps to be taken in concept development should include: (1) the training of a new group of dogs in sufficient number to provide meaningful comparative results, and (2) the conduct of tactical problems employing the tactical concept.

The recent field experiments were greatly restricted by having available only two dogs and one assigned dog handler to generate all of the expected results. On occasion, only one of the two dogs would be available for duty, so that it was impossible to gather any corroborating data. It is recommended that a sizable number of dogs (at least 12) be trained and available for future studies. The importance of the training aspects of the program cannot be too heavily stressed. Sgt. Bennett has described in some detail a recommended training program which is reproduced in Appendix F of this report. The Battelle personnel heartily concur with this program. Certain points in training should be emphasized. During training, dogs should be exposed to both male and female personnel as test subjects. There appears to be a scent difference, and the dogs should be able to detect marked personnel of either sex in some tactical situations. The dogs should be conditioned to work in the presence of distracting influences such as moving vehicles, noisy moving people, gunfire, other animals, etc. Areas free of distraction are usually difficult to find in a hostile country. A strong dog-dog handler.

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association is required if the handler is to correctly interpret the alerting response of his dog with a high degree of accuracy. Dogs should be trained to accomplish a single task if the optimum level of performance is desired. Squalene-detection dogs could be trained to identify marked personnel, or to track such marked persons, or even to seek out and locate squalene-marked materiel. However, as any one dog is trained for more than one of these tasks, it can be expected that his level of proficiency will be diminished in each additional task. Finally, a constant (daily and day-long) program of identification training and physical conditioning must be maintained if the dogs are to retain a high level of proficiency. Dog performance decreases very rapidly after only a few days of inactivity.

A number of realistic operational tactics can be rather easily developed to test the results of such a training program. A number of them could be evaluated in locations other than active battle sites. This is mentioned because of the practical limitations that can be placed on field experiments conducted in proximity to guerrilla activities, as was experienced in this study. Climate ranging from tropical rain forests to arctic tundra can be found in the Americas. The Hawaiian Islands have some intriguing terrain types that bear consideration. The tactical situations can best be envisioned by military personnel who are experiencing firsthand the problems of COIN operations, with perhaps some advice from biologists as to what experimental conditions would best constitute a valid evaluation. Planners should be guided by remembering that the concept is based on control of personnel movement. The need for such a tactical aid was readily demonstrated by the enthusiasm expressed by military personnel while the experiments were under way in Vietnam.

Studies should be continued to uncover additional marking agents. The vulnerability of being limited to a single substance which is so cheap and readily available requires no further amplification.

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APPENDIX A

EXPERIMENTAL PLANS FOR  
PHASE I (DOG CAPABILITIES) AND PHASE II (PERSISTENCE)

NOTE: The contents of this Appendix have been copied verbatim from the original documents in the interest of legibility.

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ADVANCED RESEARCH PROJECTS AGENCY  
RESEARCH AND DEVELOPMENT FIELD UNIT  
APO SAN FRANCISCO 96243

PLAN FOR SQUALENE  
MTI FIELD EXPERIMENT  
(2J-404.0)

Phase I - Dog Capabilities (U)

A. (K) PURPOSE:

1. To investigate the capabilities of dogs to respond to the squalene/man scent in the environment of a south central portion of the Republic of Vietnam.
2. To investigate the capabilities of dogs to respond to materiel marked with squalene in the environment described in A.1. above

B. (K) SCOPE:

1. Definitions.

a. Response - a characteristic reaction or behavior of the dog to the squalene/man or squalene scent.

b. Mark - to intentionally contaminate a person or object with squalene.

2. Phase I will be conducted in the vicinity of the Military Dog Training Center, Thanh Tuy Ha, Bien Hoa province, Republic of Vietnam.

3. The Phase I experiments will be conducted during a period of about two days, and will begin in September 1965.

4. Participating personnel:

a. Personnel conducting the Phase I experiments will include:

Dr. A. C. Peters, Battelle Memorial Inst.

Mr. W. H. Allton, Battelle Memorial Inst. (Project Officer).

Capt. James C. Rowe, ARPA, RDFU-V.

Lt. Huynh Thach Thuan, CDTC, ARVN.

SFC R. D. Bennett, TDY to JRATA.

S/Sgt R. C. Schmidt, TDY to ARPA, RDFU-V.

Sgt. C. M. Krotine, TDY to ARPA, RDFU-V.

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b. Test and control subject personnel will include:

10 male soldiers, 3rd Bn, 52nd Inf, 10th Inf Div, ARVN.

10 female from ARVN Women's Armed Forces Training Center, Saigon.

c. Two trained German Shepherd dogs, TDY from Ft. Benning, Georgia.

d. The personnel in B.4.b. above on the second day of experiments must be totally different individuals from those of the first day.

C. (K) OBJECTIVES:

1. To determine if there is a response to unmarked Vietnamese of both sexes, because of any characteristic or naturally occurring background body scent.

2. To determine if there is a response to marked Vietnamese personnel scattered among unmarked personnel.

3. To determine if there is a response to marked Vietnamese concealed from view by natural terrain features when approached from a distance, and if the dog will seek out such marked personnel.

4. To determine if there is a response to Vietnamese, some of whom are marked, when in view but approached from a distance.

5. To determine if the subject dogs will follow a fresh squalene/man trail or spoor.

6. To determine if there is a response to unmarked materiel when statically displayed.

7. To determine if there is a response to statically displayed items of materiel, some of which are marked.

8. To determine if there is a response and or attempt to locate materiel concealed behind terrain features when some of the materiel is marked.

D. (K) EXPERIMENT DESIGN:

1. Methodology

a. General

(1) Dogs will work individually.

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(2) Each dog will perform each experiment.

(3) Whenever possible, dogs will work downwind from the test personnel or objects.

(4) Dog handlers will have no prior knowledge of the number or location of marked personnel or materiel.

(5) Certain environmental data will be recorded for each day of the experimental period (see Annex A).

(6) All results will be recorded as in Annex A.

(7) Whenever possible, experiments will be recorded by still and motion picture photography.

(8) Random distributions will be determined from published tables of random numbers.

(9) Personnel will be marked with a gun patch containing about 10 mg. Squalene unless otherwise noted.

b. Objective C.1. - 20 unmarked Vietnamese (10 Males and 10 females) will be formed into one rank, in random order, at intervals of about 3 meters. The entire rank will be checked by each dog and results recorded in Annex A. This test will be repeated twice in succession on the second day in an attempt to confuse the handlers and dogs.

c. Objective C.2. - The same personnel will be assembled in a similar formation but in a different random order. Six (6) of the 20 personnel will be marked at random with about 10 mg squalene on a gun patch pinned to the shirt. The entire rank will be checked by each dog and the results recorded in Annex A. This test will be repeated on the second day using entirely different personnel.

d. Objective C.3. - Three marked personnel will be concealed on the perimeter of a clearing at scattered intervals of at least 8 meters and behind natural terrain features. From a distance of at least 50 meters from the concealed personnel, each dog will be led into the area and advance slowly towards the hidden persons. Record results in Annex A.

e. Objective C.4. - Six (6) unmarked personnel will be located in the open along the perimeter of a clearing at intervals of 5 to 8 meters. The dogs will be led into the area as in D.1.d. above. Results will be recorded in Annex A. After removing the dog from the area, randomly mark three (3) of the six (6) persons. Repeat the test and record results in Annex A.

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f. Objective C.5.

On the second day, mark one Vietnamese, boots with approximately 50 mg of squalene. Have the man traverse a trail approximately 1 km long. The trail will include roadway, footpaths, grass and woods. The man will then hide. Twenty minutes after the man leaves the starting point the dog will be taken to the starting point. Record results in Annex A.

A different man and trail will be used for the second dog.

g. Objective C.6.

Ten weapons, ten boxes of ammunition, ten items of clothing and ten sacks of rice will be assembled in an unmaned static display. Have the dogs check the material.

h. Objective C.7.

Remove the dogs from the area and mark three of each category of material. Have the dogs check the material. Record results in Annex A.

i. Objective C.8.

Assemble six bundles of material consisting of four items; one item from each category listed under D.1.g. Each item in three of the bundles will be marked. Conceal all six bundles in natural terrain features at intervals of at least eight meters. Bring the dog into the area from approximately 50 meters distance and advance slowly on the concealed material. Record results in Annex A.

2. (K) Limitations and Variables

a. Accidental contamination of personnel conducting the experiment is a limitation. Extensive caution will be exercised in the handling of the squalene. Personnel conducting the experiment should only supervise the handling of squalene.

b. Only certain test sites are reasonably secure from VC activities. However, sufficient secured areas are available for test sites and should preclude this from being a serious limitation.

c. The physical condition of the dogs on test days is a variable which cannot be predicted but will be recorded in Annex A.

d. Weather conditions are variable, cannot be predicted accurately, but will be recorded in Annex A.

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3. (K) Support Requirements

a. Personnel and dogs are listed in B.4.a. and b. Personnel in B.4.a. are on Official Orders. Personnel in B.4.b. and d. will be obtained by coordination with JGS, RVNAF.

b. Non-expendable material.

(1) Transportation is already available.

(2) Material in D.1.g. above will be obtained from the 3rd Bn, 52nd Inf, 10th Inf Div through JGS, RVNAF.

(3) Tape measure, wet and dry bulb thermometer or sling psychrometer, rain gauge, graduate cylinder (1 pint or 500cc.), compass and 16mm slide camera will be obtained through local supply channels.

c. Expendable material.

(1) Gun patches, safety pins and medicine droppers will be procured through local supply channels.

(2) Seventy gallons of water-emulsifiable squalene have been received from CONUS and are on hand. An additional seventy gallons is in transit from CONUS.

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Project Officer

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ANNEX A

DATA SHEET AND OBSERVATIONS

\_\_\_\_\_ Time and Date

A. Weather Data:

1. Temperature\_\_\_\_\_.
2. Wind: Direction\_\_\_\_\_ velocity\_\_\_\_\_.
3. Humidity\_\_\_\_\_.
4. Amount of rain in past 24 hours\_\_\_\_\_.
5. Ambient conditions during past 24 hours\_\_\_\_\_.
6. Ambient conditions during test period\_\_\_\_\_  
\_\_\_\_\_.
7. Location and description of test site\_\_\_\_\_  
\_\_\_\_\_.

B. Objective C.I. First Day.

1. Dog A\_\_\_\_\_.
2. Random ORDER of 10 Female in Rank of 20.  
3, 4, 6, 7, 10, 11, 13, 15, 18, 20
3. 20 UNMARKED Personnel
  - a. No. true neg. resp\_\_\_\_\_
  - b. No. false positive response\_\_\_\_\_
  - c. Time elapsed\_\_\_\_\_ minutes, total passes\_\_\_\_\_ Downwind?\_\_\_\_\_
4. Dog B\_\_\_\_\_
5. Same random order

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6. 20 unmarked personnel

- a. No. true negative responses \_\_\_\_\_
- b. No. false positive responses \_\_\_\_\_
- c. Time elapsed \_\_\_\_\_ minutes, total passes \_\_\_\_\_ downwind? \_\_\_\_\_

7. Narrative Remarks: \_\_\_\_\_

C. Objective C2, First Day

1. Dog A \_\_\_\_\_

2. Random order of 10 female in Rank of 20

3, 5, 6, 9, 10, 13, 15, 16, 17, 19

3. Random order of 6 marked personnel

3, 4, 7, 14, 17, 18 (4 male; 2 female)

4. 6 marked and 14 unmarked personnel

- a. No. true positive responses \_\_\_\_\_
- b. Location of positive responses \_\_\_\_\_
- c. No. false positive responses \_\_\_\_\_
- d. No. true negative responses \_\_\_\_\_
- e. No. false negative responses \_\_\_\_\_
- f. Time elapsed \_\_\_\_\_ minutes, total passes \_\_\_\_\_ downwind? \_\_\_\_\_
- g. Remarks \_\_\_\_\_

5. Dog B \_\_\_\_\_

6. Random order as in C2 above

7. Random order of marked personnel as in C3 above

- 8. a. No. true positive responses \_\_\_\_\_
- b. Location of all positive responses \_\_\_\_\_
- c. No. false positive \_\_\_\_\_

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ANNEX A

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- d. No. true negative \_\_\_\_\_
- e. No. false negative \_\_\_\_\_
- f. Time elapsed \_\_\_\_\_ minutes, total passes \_\_\_\_\_ downwind? \_\_\_\_\_
- g. Remarks \_\_\_\_\_  
\_\_\_\_\_

D. Objective C3

- 1. Sketch of location of concealed personnel: Note wind direction and estimated velocity, character of terrain, distances, locations of personnel, etc.

Dog A

- 2. Distance from target at which dog first gave response (if any) \_\_\_\_\_
- 3. Did dog seek out one or more targets? \_\_\_\_\_
- 4. Narrative description: downwind? \_\_\_\_\_

Dog B

- 5. Same as D2 \_\_\_\_\_
- 6. Same as D3 \_\_\_\_\_
- 7. Same as D4 \_\_\_\_\_

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ANNEX A

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E. Objective C4

1. Same as D1

Dog A

2. Same as D2 \_\_\_\_\_
3. Same as D3 \_\_\_\_\_
4. Narrative Description: Downwind? \_\_\_\_\_

Dog B

5. Same as D2
6. Same as D3
7. Same as D4
8. Random order of 3 marked personnel  
1 - 4 - 6

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ANNEX A

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Dog A \_\_\_\_\_

- 9. Same as D2 \_\_\_\_\_
- 10. Same as D3 \_\_\_\_\_
- 11. a. No. of true positive responses \_\_\_\_\_  
b. Location of all positive response \_\_\_\_\_  
c. No. of false positive \_\_\_\_\_  
d. No. of true neg. \_\_\_\_\_  
e. No. of false neg. \_\_\_\_\_  
f. Time elapsed \_\_\_\_\_, downwind? \_\_\_\_\_  
g. Remarks \_\_\_\_\_  
\_\_\_\_\_

Dog B \_\_\_\_\_

- 12. Same as D2 \_\_\_\_\_
- 13. Same as D3 \_\_\_\_\_
- 14. a. No. true positive \_\_\_\_\_  
b. Location of all positives \_\_\_\_\_  
c. No. false positive \_\_\_\_\_  
d. No. true neg. \_\_\_\_\_  
e. No. false neg. \_\_\_\_\_  
f. Time elapsed \_\_\_\_\_ minutes, downwind? \_\_\_\_\_  
g. Remarks \_\_\_\_\_  
\_\_\_\_\_

F. Objective C5

Dog A \_\_\_\_\_

- 1. Dogs reaction at starting point

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ANNEX A

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2. Time elapsed to locate test subject

3. Narrative remarks. Downwind? \_\_\_\_\_

Dog B \_\_\_\_\_

4. Same as F1 \_\_\_\_\_

5. Same as F2 \_\_\_\_\_

6. Same as F3 \_\_\_\_\_

G. Objective C6

Dog A \_\_\_\_\_

1. a. No. true neg. responses \_\_\_\_\_

b. No. false positive responses \_\_\_\_\_

c. Time elapsed \_\_\_\_\_, total passes \_\_\_\_\_, downwind? \_\_\_\_\_

d. Remarks \_\_\_\_\_

Dog B \_\_\_\_\_

2. a. Same as Gla \_\_\_\_\_

3. b. Same as G1b \_\_\_\_\_

c. Same as G1c \_\_\_\_\_

d. Same as G1d \_\_\_\_\_

H. Objective C7

1. Random order of 3 marked items in each category: 1 - 4, 5, 10  
2 - 7, 8, 10  
3 - 5, 6, 10  
4 - 2, 5, 9

Dog A \_\_\_\_\_

2. a. No. of true positive responses in category 1 \_\_\_\_\_, 2 \_\_\_\_\_, 3 \_\_\_\_\_,  
4 \_\_\_\_\_

b. No. of false positive responses in category 1 \_\_\_\_\_, 2 \_\_\_\_\_, 3 \_\_\_\_\_,  
4 \_\_\_\_\_

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c. No. of true negative responses in category 1\_\_\_\_, 2\_\_\_\_,  
3\_\_\_\_, 4\_\_\_\_

d. No of false negative responses in category 1\_\_\_\_, 2\_\_\_\_,  
3\_\_\_\_, 4\_\_\_\_

3. Time elapsed\_\_\_\_, downwind?\_\_\_\_

4. Remarks\_\_\_\_\_  
\_\_\_\_\_

Dog B\_\_\_\_\_

5. a. Same as H2a\_\_\_\_\_

b. Same as H2b\_\_\_\_\_

c. Same as H2c\_\_\_\_\_

d. Same as H2d\_\_\_\_\_

6. Time elapsed\_\_\_\_, downwind?\_\_\_\_

7. Remarks\_\_\_\_\_  
\_\_\_\_\_

I. Objective C8

1. Random order of 3 marked bundles (3 of 6) 1, 4, 5

2. Sketch of location of concealed. Note wind direction and velocity,  
character of terrain, distances, location of concealed bundles and  
photos. (sic)

Dog A\_\_\_\_\_

3. Distance from target at which dog first gave response\_\_\_\_\_

4. Did dog seek out one or more targets?

5. Did dog appear confused?

6. Narrative description: Downwind?\_\_\_\_\_

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ANNEX A

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Dog B \_\_\_\_\_

- 7. Same as I3 \_\_\_\_\_
- 8. Same as I4 \_\_\_\_\_
- 9. Same as I5 \_\_\_\_\_
- 10. Same as I6 \_\_\_\_\_

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ANNEX A

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PLAN FOR SQUALENE MTI

FIELD EXPERIMENT  
(2J-404.0)

Phase II - Persistence (U)

A. (K) Purpose:

1. To investigate by controlled field experiments the persistence of squalene when applied to selected terrain in the environment of South East Asia.
2. To investigate by controlled field experiments the persistence of squalene on indigenous personnel in the environment of South East Asia.

B. (K) Scope:

1. Definitions.
  - a. Response - a characteristic reaction or behavior of the trained dog to the squalene/man or squalene scent.
  - b. Mark - to intentionally contaminate a person or object with squalene.
  - c. Day 1 - the day on which squalene is applied to a test plot.
2. Phase II will be conducted in the vicinity of the ARVN Military Dog Training Center, Thanh Tuy Hc, Bien Hoa Province, Republic of Vietnam.
3. Phase II experiments will initially be conducted during the wet season, and then repeated during the dry season in order to exploit the seasonal weather variations of Vietnam.
  - a. The first series of Phase II experiments will commence about 11 October 1965.

They will continue for about six weeks, and will be adjusted in accordance with cumulative experimental results.
  - b. The Phase II experiments will be repeated commencing about 22 November 1965, and will be similarly adjusted in accordance with experimental results.

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4. Participating personnel:

a. The preparation of the Phase II experimental program and drafting of the final written report will be directed by Dr. A. C. Peters, Battelle Memorial Institute.

b. Personnel conducting the Phase II experiments will include:

(1) Mr. Wayne H. Allton, Jr., Battelle Memorial Institute  
(Project Officer)

(2) Capt James C. Rowe, ARPA/RDFU-V

(3) Lt Huynh Thach Thuan, CDTC, ARVN

(4) SFC R. D. Bennett, TDY to JRATA

(5) S/Sgt R. C. Schmidt, TDY to ARPA/RDFU-V

(6) Sgt G. M. Krotine, TDY to ARPA/RDFU-V.

c. Test and control subjects will be personnel from the 3rd Bn, 52nd Inf, 10th Inf Div, ARVN. It is anticipated that at least 50 troops will be needed for the Phase II experiments. Additional personnel may be needed for dog training.

d. Two (2) trained German Shepherd dogs, TDY from the 26th Scout Dog Plt, Fort Benning, Georgia are also available.

C. (K) Objectives:

1. To determine the length of time a designated area and type of foliage sprayed with a known amount of squalene will continue to mark personnel traversing the area.

a. To study the persistence of squalene on vegetation under conditions of the naturally occurring wet and dry seasons of South East Asia.

b. To determine, if circumstances permit, the influence of the rate of application of squalene on the persistence of squalene on vegetation.

2. To determine the length of time that personnel will remain marked with squalene acquired by walking through a delineated area of terrain to which a known amount of squalene has been applied.

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a. To determine the persistency of marking of personnel over a period of time when clothing and footwear remains unlaundered.

b. To determine the persistency of marking of personnel when the test subjects wear the test clothing which is laundered at prescribed time intervals.

c. To determine the persistency of marking of personnel when the test subjects change their clothing for unmarked clothing at prescribed intervals.

D. (K) Methodology:

1. General

a. Each dog will perform each task individually.

b. Whenever possible, dogs will work downwind from experiment personnel.

c. Identification will be conducted at a site away from the marking test plot. Marking will be determined by the registering of positive responses by the trained dogs.

d. Dog handlers will have no prior knowledge of the number or location marked personnel.

Certain environmental data will be recorded for each experiment A.

All experimental results will be recorded on Data Sheets in

e. Experiments will be recorded by still and motion picture photography.

f. Random distributions will be determined from published tables of random numbers.

g. Test plots will measure about 20 meters wide and 30 meters long. All personnel traversing the test plot will parallel the long (30 meter) axis.

h. Selected test plots will have delineated perimeters, and will be inoculated with a measured amount of water-emulsifiable squalene by means of a hand sprayer.

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k. All measures of persistency and marking will be assessed by recording the responses of the trained dogs to exposed test subject and un-exposed control personnel.

2. Objective C.1.a.

a. On Day 1, three test subjects will traverse the un-sprayed test plot and then join seven control subjects for a line-up identification procedure as described in the Phase I protocol. Results will be recorded. The test plot will then be sprayed with the selected concentration of squalene (rate equivalent to seven pounds of squalene per acre). Fifteen or more minutes later, the same three (3) test subjects will again traverse the test plot, and then will be randomly distributed among seven (7) control personnel for a line-up identification procedure. Results will be recorded.

b. On Day 2, three new test subjects, previously determined to produce no response, will walk through the test plot, and will then be taken with seven controls to a site for line-up identification. Record results.

c. The above procedure will be continued at periodic intervals of about three days, using new people each day for test subjects, until such time as the dogs can no longer make positive identifications. Control subject personnel should be rotated daily in order to preclude the possibility of individual identification by the dogs or handlers. The dogs should follow a daily training program in order to minimize bias through prior knowledge of known test days. Whenever possible, dogs and handlers will not know if a particular identification trial is for training or test purposes.

3. Objective C.1.b. Providing there is sufficient time, and that sufficient numbers of ARVN test and control subjects can be made available, the experiment detailed in D.2. above will be repeated, simultaneously employing three separate but similar test plots. Each plot will be sprayed on Day 1 with a different amount of squalene, equivalent to rates of 1-2, 6-7, and 20-22 lbs. of squalene per acre. Daily identification results will be recorded in Annex A.

4. Objective C.2.a.

a. On Day 1 of paragraph D.2. above, three separate test subjects will walk through the sprayed test plot and then proceed for identification with seven controls. They will then be carefully instructed to return for identification on designated days; that they are to wear this same clothing to each identification session; and that they are not to launder this particular uniform until specifically directed to do so (at the end of this experiment). The same instructions will apply to their footwear. No instructions will be given for personal body hygiene procedures, or restricting their wearing of this uniform on days other than those of identification sessions; because it is unlikely that a truly representative "average" situation could be postulated.

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b. On Days 5 and 10 of D.2. above, three additional men will traverse the test plot for marking exposure. Following the identification procedure they will be given the same set of instructions outlined in the preceding paragraph. These latter test subjects will be tested for persistency of marking at intervals of 2-3 days. Results will be recorded.

5. Objective C.2.b. The same test personnel used for D.2. (Objective C.1.a) will also be used for this objective. Following the first day of test plot exposure for marking, the test subjects will be instructed to return on specified days at intervals of 2-3 days. They are to always wear the clothing and footwear worn during the first marking exposure. Further, they will only launder this particular clothing when specified (once between the fifth and seventh days after marking, and once again between the 11th and 13th days after marking). Dog identification responses will be recorded.

6. Objective C.2.c. On the first day of marking trials (Day 1) three separate test personnel will walk through the treated test plot and proceed to the check point for identification. They will then be instructed to return each day for the next five days for identification purposes. On each day, these three test subjects shall wear fresh unmarked clothing and footwear which has not been worn previously during that week (there must be six uniforms available to each of these men at the beginning of this experiment). On Day 8, three new test subjects will walk through the test plot and proceed for identification. They will follow exactly the same procedure just described, returning each day in fresh clothing and footwear for identification, for five or six days. Results will be recorded.

E. (K) Limitations and Variables:

1. Accidental contamination of personnel and terrain is a probable limitation. Preliminary dog training sessions at the ARVN Military Dog Training Center have already demonstrated that incidental body contact is sufficient to transfer detectable amounts of squalene from marked to unmarked personnel. Excellent cooperation and communications between ARVN and American personnel will be required to complete this experimental plan and effectively control accidental contamination. The interpretation of results will also attempt to account for this factor.

2. The lack of total direct conversation and control of test and control personnel is a limitation. The experimental design is straightforward, but requires personnel control and time scheduling for the most satisfactory and clearly defined results. Extensive cooperation with all ARVN personnel will be used to minimize this limitation.

3. As noted in the Phase I protocol, there are a limited number of test sites available to this experimental program, with a limited range of terrain and vegetation types included. Squalene will be applied to the selected test plots by hand sprayer; thus, the quantity of squalene applied can be

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controlled. However, the uniformity of distribution may be variable, and the degree of saturation of the squalene emulsion from the top of the foliage to the ground level may not accurately simulate a distribution pattern achieved by airborne spray equipment.

4. The daily physical condition of the dogs can be a performance variable. This cannot be controlled, but any observed deviations from the normal will be noted and recorded.

5. The daily weather conditions will be a variable which can materially influence daily performance and results. Basic weather data, such as temperature, humidity, wind direction and velocity, and rainfall will be recorded daily.

F. (U) Support Requirements:

1. Personnel requirements have already been identified in B.4. above.
2. Both non-expendable and expendable material requirements have been detailed in the Phase I protocol, D.3.b and c.

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9/28/65

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# ELAPSED DAY OF EXPERIMENT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total men/objective
C.1.a.		3	3			3				3		3			3			3		21
C.1.b.																				
C.2.a. (No launder)		3 *			*	3		*			3									9
C.2.b. (Same personnel as in C.1.a.)		3	3			3	Laundry 3	Laundry		3	Laundry 3	Laundry 3	Laundry 3				Laundry 3	Laundry 3		21 (Same men as in C.1.a.)
C.2.c. Fresh clothes daily		3	*	*	*	*				3	*	*	*	*						6

## DAILY MANPOWER REQUIREMENTS

36 Test  
14 Control  
50

NOTE: Signifies identification session.

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Annex A

Weather Observations

A. Daily Record of Weather Data

1. Date and time of observations \_\_\_\_\_
2. Temperature \_\_\_\_\_
3. Wind direction \_\_\_\_\_ velocity \_\_\_\_\_
4. Relative humidity \_\_\_\_\_ %
5. Amount rainfall in past 24 hours \_\_\_\_\_
6. Ambient conditions during past 24 hours \_\_\_\_\_  
\_\_\_\_\_
7. Ambient conditions during day's test period \_\_\_\_\_  
\_\_\_\_\_
8. Location and description of test site \_\_\_\_\_  
\_\_\_\_\_
9. Remarks \_\_\_\_\_

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Annex A  
Data Sheet

- B. Objective: \_\_\_\_\_
1. Day \_\_\_\_\_
  2. Special instructions \_\_\_\_\_
  3. Random order for 3 marked personnel \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_
  4. Concentration of squalene on test plot \_\_\_\_\_ lbs./acre
  5. Dog A \_\_\_\_\_
    - a. Ten unmarked personnel
      - 1) No. true neg. \_\_\_\_\_, no. false positive \_\_\_\_\_
      - 2) Time elapsed \_\_\_\_\_ min., total passes \_\_\_\_\_, downwind? \_\_\_\_\_
      - 3) Remarks \_\_\_\_\_
  6. Dog B \_\_\_\_\_
    - a. Ten unmarked personnel
      - 1) No. true neg. \_\_\_\_\_, no. false pos. \_\_\_\_\_
      - 2) Time elapsed \_\_\_\_\_ min., total passes \_\_\_\_\_, downwind? \_\_\_\_\_
      - 3) Remarks \_\_\_\_\_
  7. Dog A \_\_\_\_\_
    - a. Three marked and seven control subjects
      - 1) No. true pos. \_\_\_\_\_, no. false pos. \_\_\_\_\_
      - 2) No. true neg. \_\_\_\_\_, no. false neg. \_\_\_\_\_
      - 3) Time elapsed \_\_\_\_\_ min., total passes \_\_\_\_\_, downwind? \_\_\_\_\_
      - 4) Remarks \_\_\_\_\_

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8. Dog B \_\_\_\_\_

a. Three marked and seven control subjects

1) No. true pos. \_\_\_\_\_, no. false pos. \_\_\_\_\_

2) No. true neg. \_\_\_\_\_, no. false neg. \_\_\_\_\_

3) Time elapsed \_\_\_\_\_ min., total passes \_\_\_\_\_, downwind? \_\_\_\_\_

4) Remarks \_\_\_\_\_

(delete inapplicable sections)

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APPENDIX B

DAILY LOG OF PHASE I EXPERIMENT

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APPENDIX B

DAILY LOG OF PHASE I EXPERIMENT

6 October 1965

Phase I - Day 1

0730 Clear and sunny - 1.36 inches of rain in last 24 hours

0800 Temp. = 84°F

Humidity = dry - 79°F

wet - 77°F

Wind direction - variable; SW & SE to NW & NE

Wind velocity - 0 to 2 knots

10 troops from the 52nd

9 WAC's from Saigon

Location - west end of VC Village area at MUIC. Grass cut and low,  
scrub brush to 5 ft high.

Objective C. 1.

B. 1. Dog A - Buddha

2. Random order - by choice, not by book of random numbers

3. a. No. true neg. resp. = 18 (out of 19)

b. No. false positive resp. = 1 alert on male (see remarks) removed  
from lineup.

c. Time elapsed = 10 min.

Total passes = 4 - downwind

4. Dog B - Benjie

5. See B2 above

6. a. No. true neg. resp. = 17 (out of 19)

b. No. false positive resp. = 2 alerts on males (see remarks)

c. Time elapsed = 15 min; total passes = 3 - downwind

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7. Remarks:

The three men that the dogs gave an alert on were interrogated. It was found that these three had been at MDTC 3 days before as part of the training program. Two had been marked, the third was probably contaminated. They were removed from the area. We continued with 7 men and 9 WAC's.

Objective C. 2.

C. 1. Dog A - Buddha

2. See B2 above

3. Random order of 6 marked personnel

1, 4, 7, 9, 13, 14 (3 male and 3 female)

4. 6 marked and 10 unmarked personnel

ⓕ FM Ⓜ FF Ⓜ F ⓕ MMF Ⓜ ⓕ FM

a. No. true positive resp. = 1 out of 6

b. Location of all positive responses = 1, 11, 16

c. No. false positive resp. = 2

d. No. true neg. resp. = 8

e. No. false neg. resp. = 5

f. Time elapsed - 15 min; total passes = 6 downwind

g. Remarks: It is hot but dog appears to be working ok; easily distracted by movement

5. Dog B - Benjie

6. Random order as in C3 above

7. Random order as in C4 above

8. a. No. true positive resp. = 4 out of 6

b. Location of all positive resp. = 1, 3, 4, 5, 7, 13

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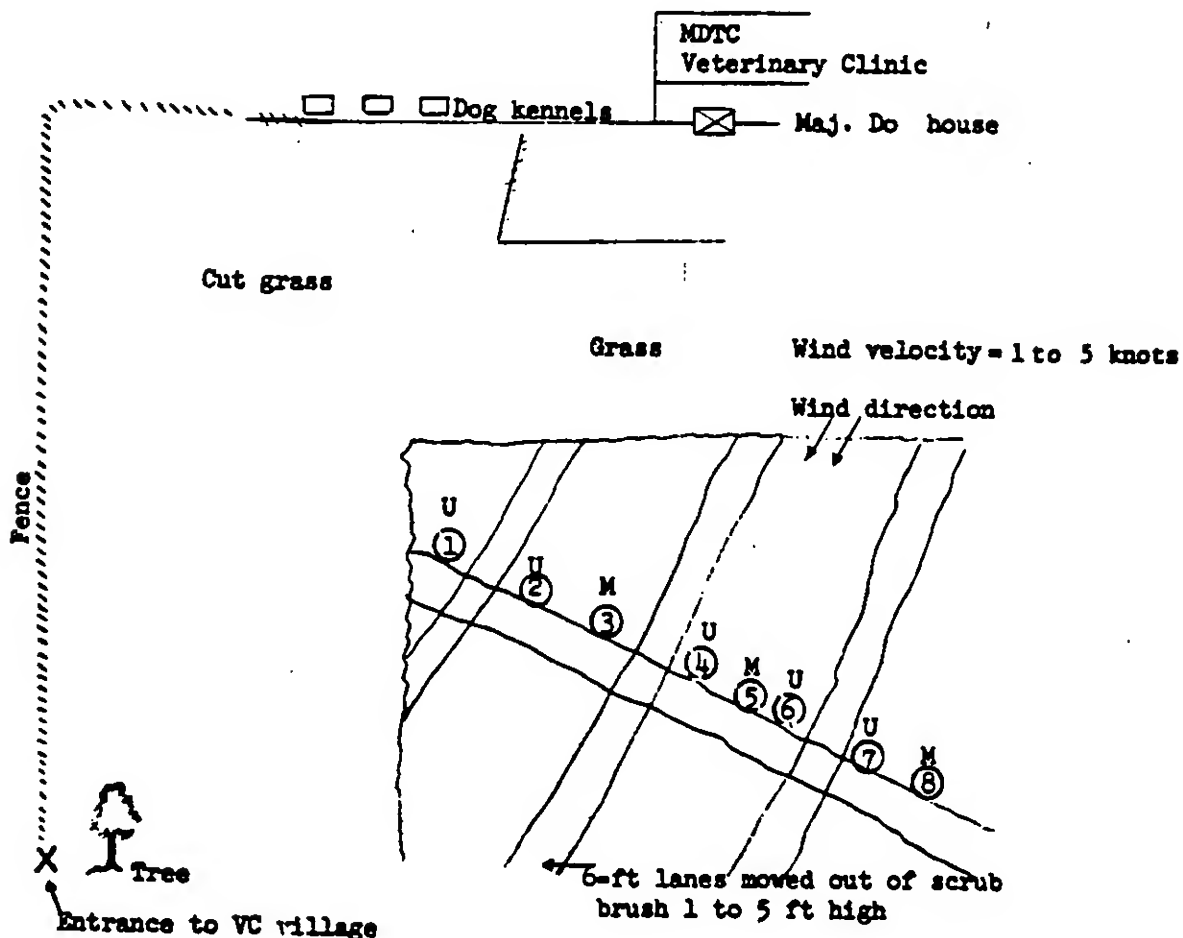
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- c. No. false positive resp. = 2
- d. No. true negative resp. = 8
- e. No. false negative resp. = 2
- f. Time elapsed = 17 min; total passes = 7 downwind
- g. Remarks: Wind fairly steady (0 to 3 knots); very hot but dog working well; easily distracted

Objective C. 3.

D. 1.



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B-4

Three marked and three unmarked males were concealed in brush 8 to 10 ft upwind from the mowed lanes. U = unmarked; M = marked. The dogs proceeded down the mowed lane as shown on the sketch. They both made one pass up and one pass back only.

Dog A - Buddha

2. All responses because of the set-up are from a distance of 8 to 10 ft.
3. Buddha sought out 3 targets:
  - 1 true positive and 2 false positive, Targets Nos. 3, 6, 7 (see sketch)
4. Remarks: We used males only because we felt dogs were not giving a strong alert on marked females (from Objective C2 above) and did not wish to introduce the added variable of sex in this objective. Dog appears to be working ok although it is very hot.

Dog B - Benjie

5. See D2 above
6. Benjie sought out 4 targets
  - 3 true positive and 1 false positive, Targets Nos. 3, 5, 6, 8 on sketch
7. Targets Nos. 5 and No. 6 moved before dog gave strong alert (which precipitated a strong alert). Handler says he must call it a strong alert, however.
8. Remarks: The first 2 weeks Buddha worked better, gave a definite strong alert and identified marked personnel better than Benjie. Now it is just the reverse.

Possible reasons:

1. Heat affects Buddha more than Benjie

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B-5

2. Remarks by SFC Bennett: In the first day of training Buddha and Benjie worked very well. The next day of training we received the same ARVN troops back, when we were supposed to receive new ones. We asked the troops that had been marked the day before with squalene to fall out. Then we put the rest of them in a lineup. The dogs picked out about 6 more of them that were not supposed to be marked and, through questioning them, we found out that they had touched the men that had squalene on the day before. After pulling these men out of the line the dogs worked well on the rest of them. But every day we would receive some of the troops back that we used before. We tried to tell the 52nd Infantry that we could not use the same troops, but we could not get cooperation from them. Because of this situation we did not know when to correct the dogs on false alerts. Also, we had trouble trying to keep the same interpreter. They would change interpreters on us each day, and some of them could not understand English well enough to tell the troops what we wanted. This was another reason why so many troops were marked with squalene that should not have been. We could not make the interpreter understand that the troops had to be kept separated once they were marked with squalene. Therefore, I feel that the dogs did not get proper training before going into Phase I of the testing. Also, I do not believe female personnel should be used when the dogs have never been trained on them.

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B-6

Objective C. 4.

1. Location was in the open, cut grass area shown in the upper-left corner of sketch (page B-3). Dogs worked downwind (velocity 1 to 5 knots) starting about 30 yd from targets. Each made 4 or 5 (a total of 4 or 5) passes 30, 15, 10, and 6 ft from targets.

Used 3 females and 3 males (unmarked)

Random order - FMFFMM

Dog A - Benjie

Picked up male No. 5 at 6 ft. Upon questioning, found out this was one of the three marked men we picked up this A.M. He had gone up to the canteen, got drunk, and was playing the clown. Rt. foot successfully suppressed. We proceeded with 2 males and 3 females.

Dog B - Buddha

Gave 3 false alerts (on the unmarked personnel)

Targets Nos. 1, 2, 6

Marked 2 males and 1 female as shown:

Random order - F (M) (F) F (M)

Dog A - Benjie

Gave a strong alert on 2 targets (2 true positive) Nos. 2 and 5 above. No. 2 at 15 ft and No. 5 at 6 ft. Benjie gave a possible alert on the female (No. 3 above). Stopped but would not give a strong alert. Handler suspects female is marked but will not give a definite yes answer.

Dog B - Buddha

Same random order of marked personnel,

i.e., F (M) (F) F (M)

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B-7

Buddha gave 3 alerts - 2 true positive

(Nos. 2 and 5 above) both at 30 ft.

1 false positive (No. 1 above) at 6 ft.

Will not work properly, dog keeps heading for the shade.

1600 Dogs getting too hot; had to stop work for today.

All test personnel wear a gun patch pinned to right blouse pocket.

Marked personnel received 4 drops of a 1:4 squalene-water emulsion;  
controls received 4 drops of water on gun patch.

7 October 1965

Phase I - Day 2

0730 Cloudy, overcast

No rain in last 24 hours

0830 Temp. = 83°

Humidity = dry - 79.5°

wet - 78.0°

Wind direction - fairly steady, south to north

Wind velocity - 0 to 3 knots.

8 (new) WAC's from Saigon.

9 troops from the 52nd

All of the 52nd troops (except 3) have been in training program and may be contaminated with squalene. Sgt. Bennett talked with Sgt. Thuan and explained we could not proceed without new troops. Sgt. Thuan called the 52nd Batt.

0945 10 new men from Nhon Trach district.

These troops have never been near those at the 52nd previously marked with squalene.

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B-8

Objective C. 1.

1st test of unmarked personnel

1. Dog A - Benjie
2. Random order by choice
3. a. No. true neg resp. = 15 (out of 18)  
b. No. false positives = 3  
c. Time elapsed = 13 min; total passes = 4
4. Dog B - Buddha
5. See 2 above
6. a. No. true neg. resp. = 12 (out of 18)  
b. No. false positives = 6  
c. Time elapsed = 25 min; total passes = 7
7. Remarks: Random order of unmarked personnel

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
M	F	F	M	M	M	M	F	M	F	F	M	F	M	F	M	F	M

Dog A - Benjie gave 3 alerts (3b above) on Nos. 4, 5, 9

Dog B - Buddha gave 6 alerts (6b above) on Nos. 1, 2, 4, 5, 9, 14

Objective C. 1.

2nd test of unmarked personnel

1. Dog A - Benjie
2. Random order by choice
3. a. No. true negative resp. = 13 (out of 18)  
b. No. false positive resp. = 5  
c. Time elapsed = 14 min; total passes = 4
4. Dog B - Buddha
5. See 2 above

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B-9

6. a. No. true negative resp. = 11 (out of 18)  
b. No. false positive resp. = 7  
c. Time elapsed = 23 min; total passes = 4

7. Remarks:

Different order of unmarked personnel

6 11 12 14 5 2 3 16 18 8 9 10 7 1 13 15 17 4  
M F M M M F F M M F M F M M F F F M

Dog A - Benjie gave 5 alerts (3b above) on Nos. 6, 5, 9, 10, 7

Dog B - Buddha gave 7 alerts (6b above) on Nos. 6, 12, 14, 5, 16, 9, 1

Summary of two successive tests of unmarked personnel. Total alerts on:

Personnel No. 1 2 4 5 6 7 9 10 12 14 16  
Sex M F M M M M M F M M M

The dogs gave an alert on 9 of the 10 unmarked males and 2 of the 8 unmarked females. Total of 11 out of 18.

No. 5 (male) and No. 9 (male) were alerted on by both dogs in both tests.

Objective C. 2.

1. Dog A - Buddha  
2. Random order by choice  
3. Random order of 7 marked personnel

Nos. 5, 6, 7, 8, 10, 11, 12

4. 7 marked and 11 unmarked personnel

Personnel No. 18 2 5 14 3 12 11 8 6 9 10 16 1 4 7 13 15 17  
Sex M F M M (F) (M) (F) (F) M (M) (F) (M) M M M F F F

- a. No. of true positive resp. = 2 (out of 7)  
b. Location of all positive resp. = 4, 10, 12 (number in rank from left to right)  
c. No. of false positive resp. = 1

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B-10

- d. No. of true negative resp. = 10
- e. No. of false negative resp. = 5
- f. Time elapsed = 11 min; total passes = 6
- g. Remarks:

Wind velocity = 0 to 3 knots. It's very hot.

Dog (Buddha) wants to quit to go to the shade. Dog easily distracted by movie-camera noise.

- 5. Dog B - Benjie
- 6. Random order same as above (4)
- 7. Random order same as above (4)
- 8. a. No. true positive resp. = 2 (out of 7)
- b. Location of all positive resp. = Nos. 10, 11, 14, 15, 17  
(number in rank from left to right)
- c. No. of false positive resp. = 3
- d. No. of true negative resp. = 8
- e. No. of false negative resp. = 5
- f. Time elapsed 14 min; total passes = 4
- g. Remarks: Dog distracted by man located upwind, 60 ft to rear of formation under a tree. Benjie's alert on No. 10 female is the first strong alert the handlers say they have had on a female. There seems to be a definite sex factor involved. Very hot, had to stop for today.

8 October 1965

Phase I - Day 3

0730 Clear, sunny - no rain in last 24 hours

0830 Temp. = 84°

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B-11

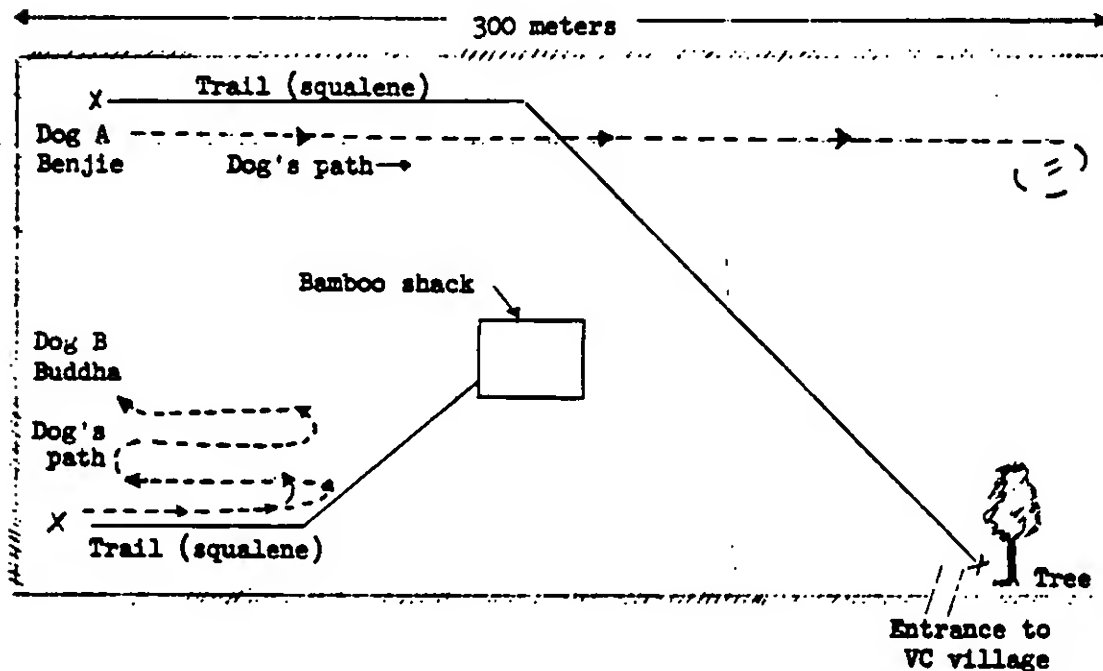
Humidity = dry - 83.5

wet - 81.5

Wind direction - variable

Wind velocity - 0 to 1 knot

0940 Put 40 drops (~2 cc) of a 1:4 water emulsion squalene on the bottom of the boots of an ARVN soldier at the NW corner of the VC Village training area. The soldier walked east down the fence line a three-fourths of the way (~200 meters) then cut across to tree at entrance. See diagram.



#### Dog A - Benjie

The trail for Benjie was through cut grass and grass 1 to 3 ft high down fence line; scrub and shrub 1 to 5 ft high in the middle of VC Village area. Benjie followed the track (and fence line) but did not cut off where trail did. She followed the fence line down to the corner then circled in the corner, she was confused. There was no indication that this dog can track.

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B-12

Dog B - Buddha

A different ARVN soldier received same amount of squalene (~2 cc of 1:4) on his boots (at SW corner). The trail was through cut grass, path, and 1 to 5-ft - high grass and shrub.

Buddha walked about 100 meters down the fence line, did not cut off where trail did. He went back and forth a couple of times. There is no indication that Buddha can track.

Objective C. 6.

Four bundles of materiel displayed in a row with 10 yards between in an open static display.

1

2

3

3 hats and 3 shirts;

M2 carbine, 45, 2 AR-15;

4 boxes ammunition;

4

2 ammunition belts.

Unmarked:

Dog A - Benjie - no response

Time elapsed 5 min; total passes = 4

Dog B - Buddha - no response

Time elapsed = 5 min; total passes = 3

Marked one item in each bundle = squalene (4 drops of 1:4)  
same open static display.

Dog A - Benjie - no response

Time elapsed = 5 min; total passes = 4

Dog B - Buddha - no response

Time elapsed = 5 min; total passes = 4

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B-13

Concealed the marked item from each bundle behind natural terrain approximately 10 yards apart.

1	2	3	4
Box ammo	Shirt	Ammo pouch	AR-15

The dogs were led past (within 6 ft downwind) each concealed item.

Dog A - Benjie

Handler states: Benjie picked up a fairly strong alert on No. 2

Note: Sweaty shirt (out of the 4 items) would contain the most human scent.

Dog B - Buddha

No response; dog wants to go to the shade; very hot; had to stop work for today.

9 October 1965

Phase I - Day 4

Meeting with Colonel Baker. His decision was to allow a 14-day extended training program and then we will repeat Phase I, Objectives C1 and C2. Upon our (all of us) recommendations. JCR

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APPENDIX C

SUMMARY OF RESULTS OF  
PHASE I EXPERIMENT - TRIALS 1, 2, and 3

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C-1

APPENDIX C

SUMMARY OF RESULTS OF  
PHASE I EXPERIMENT - TRIALS 1, 2, AND 3

Trial 1

October 6, 1965

Sixteen persons (9 female and 7 male) in lineup, none marked

Buddha: 0/0 true positive (0/0 false negative)  
16/16 true negative (0/16 false positive)

Benjie: 0/0 true positive (0/0 false negative)  
16/16 true negative (0/16 false positive)

Sixteen persons in lineup, six marked (3 female and 3 male):

Buddha: 1/6 true positive (5/6 false negative)  
8/10 true negative (2/10 false positive)

Benjie: 4/6 true positive (2/6 false negative)  
8/10 true negative (2/10 false positive)

Eight concealed persons (male only), three marked:

Buddha: 1/3 true positive (2/3 false negative)  
3/5 true negative (2/5 false positive)

Benjie: 3/3 true positive (0/3 false negative)  
4/5 true negative (1/5 false positive)

Five persons (3 female and 2 male) in open, none marked:

Buddha: 0/0 true positive (0/0 false negative)  
2/5 true negative (3/5 false positive)

Benjie: 0/0 true positive (0/0 false negative)  
5/5 true negative (0/5 false positive)

Five persons in open, three marked (1 female and 2 male):

Buddha: 2/3 true positive (1/3 false negative)  
1/2 true negative (1/2 false positive)

Benjie: 3/3 true positive (0/3 false negative)  
2/2 true negative (0/2 false positive)

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C-2

October 7, 1965

Eighteen persons (8 female and 10 male) in lineup, none marked:

Buddha: 0/0 true positive (0/0 false negative)  
12/18 true negative (6/18 false positive)

Benjie: 0/0 true positive (0/0 false negative)  
15/18 true negative (3/18 false positive)

Eighteen persons in lineup, none marked (report):

Buddha: 0/0 true positive (0/0 false negative)  
11/18 true negative (7/18 false positive)

Benjie: 0/0 true positive (0/0 false negative)  
13/18 true negative (5/18 false positive)

Eighteen persons in lineup, seven marked (4 female and 3 male):

Buddha: 2/7 true positive (5/7 false negative)  
10/11 true negative (1/11 false positive)

Benjie: 2/7 true positive (5/7 false negative)  
8/11 true negative (3/11 false positive)

Summary of Trial 1 results:

Buddha: 6/19 true positive (13/19 false negative)  
63/85 true negative (22/85 false positive)

Benjie: 12/19 true positive (7/19 false negative)  
71/85 true negative (14/85 false positive)

Trial 2

October 28, 1965

Eighteen persons (male only) in lineup, none marked:

Buddha: 0/0 true positive (0/0 false negative)  
18/18 true negative (0/18 false positive)

Benjie: 0/0 true positive (0/0 false negative)  
18/18 true negative (0/18 false positive)

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C-3

Eighteen persons (male only) in lineup, six marked:

Buddha: 1/6 true positive (5/6 false negative)  
12/12 true negative (0/12 false positive)

Benjie: 1/6 true positive (5/6 false negative)  
12/12 true negative (0/12 false positive)

Fourteen persons (male only) in lineup, five marked:

Buddha: 0/5 true positive (5/5 false negative)  
9/9 true negative (0/9 false positive)

Benjie: 0/5 true positive (5/5 false negative)  
9/9 true negative (0/9 false positive)

October 29, 1965

Troops were not available to complete the test.

Trial 3

November 8, 1965

Nineteen persons (male only) in lineup, none marked:

Buddha: 0/0 true positive (0/0 false negative)  
19/19 true negative (0/19 false positive)

Benjie: 0/0 true positive (0/0 false negative)  
19/19 true negative (0/19 false positive)

Nineteen persons (male only) in lineup, six marked:

Buddha: 4/6 true positive (2/6 false negative)  
13/13 true negative (0/13 false positive)

Benjie: 6/6 true positive (0/6 false negative)  
13/13 true negative (0/13 false positive)

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C-4

November 9, 1965

Nineteen persons (male only) in lineup, none marked:

Buddha: 0/0 true positive (0/0 false negative)  
19/19 true negative (0/19 false positive)

Benjie: 0/0 true positive (0/0 false negative)  
19/19 true negative (0/19 false positive)

Repeat search of unmarked lineup to confuse handlers.

Nineteen persons (male only) in lineup, none marked:

Buddha: 0/0 true positive (0/0 false negative)  
19/19 true negative (0/19 false positive)

Benjie: 0/0 true positive (0/0 false negative)  
19/19 true negative (0/19 false positive)

Again, repeat search of unmarked lineup to confuse handlers.

Nineteen persons (male only) in lineup, none marked:

Buddha: 0/0 true positive (0/0 false negative)  
17/19 true negative (2/19 false positive)

Benjie: 0/0 true positive (0/0 false negative)  
17/19 true negative (2/19 false positive)

Sixteen persons (male only) in lineup, six marked:

Buddha: 5/6 true positive (1/6 false negative)  
10/10 true negative (0/10 false positive)

Benjie: 0/6 true positive (6/6 false negative)  
10/10 true negative (0/10 false positive)

Summary of Trial 3 results:

Buddha: 9/12 true positive (3/12 false negative)  
97/99 true negative (2/99 false positive)

Benjie: 6/12 true positive (6/12 false negative)  
97/99 true negative (2/99 false positive)

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APPENDIX D

SUMMARY OF THE DOG TRAINING PROGRAM  
CONDUCTED PRIOR TO THE NATICK EXPERIMENTS

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D-1

APPENDIX D

SUMMARY OF THE DOG TRAINING PROGRAM  
CONDUCTED PRIOR TO THE NATICK EXPERIMENTS

This summary describes the training program employed at Fort Benning, Georgia, beginning in March, 1963, preliminary to the field experiments subsequently conducted at Natick, Massachusetts. This training program has been described by Sgt. Robert D. Bennett, U. S. Army; we are indebted to Sgt. Bennett for his efforts in assisting in the preparation of this summary. It was decided to include this summary in the description of the Vietnam field experiments because of the difference in responses obtained in the Natick field trials and the Vietnam field trials. It is believed that the difference was due in large measure to the difference in the prior conditioning and training of the dogs.

The training program conducted at Fort Benning, Georgia, consisted of one week of basic obedience training, one week of scouting training using both personnel and objects marked with squalene, one week of scouting training with partial numbers of the test subjects and objects marked with squalene, and 18 weeks of intensive lineup identification and scouting training using both marked and unmarked test personnel. Only male test subjects were used during this training.

The five dogs selected in 1963 for this experimental program had previously received some basic obedience training. They were initially given one week of basic obedience training to better acquaint them with their handlers and to improve their receptiveness to the subsequent training program (a two-week obedience training program would be far superior in giving the handlers a better knowledge of the dog). A couple of the dogs bit their handlers during the first day of training and the handlers asked to be removed from the program. Two more

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D-2

handlers were selected to handle the dogs. These two handlers had no trouble with their dogs because of their prior experience with handling dogs. These remarks are included to emphasize the importance of suitable candidates for the dog-handler role. When scouting training was begun, three decoy test subjects were placed in the training field; one decoy was marked with squalene and the two remaining decoys were unmarked. The dogs reacted in the same manner to both the unmarked and marked personnel, and after correcting them they did not respond to either marked or unmarked personnel. Training tactics were changed to use only marked personnel and marked objects (boxes, field equipment, etc.) until the dogs started reacting strongly to marked material and personnel.

The next step was to repeat scouting problems using both marked and unmarked personnel as decoys. When the dogs showed any response to alerting on unmarked personnel, the handlers would pull the dog off and keep on patrolling. Within a short period of time the dogs were adequately trained to show no response to unmarked personnel (except for one of the five dogs). Efforts were continued to train this dog to respond to the man-squalene odor, but he showed no interest in any kind of training. He was judged to be of subpar intelligence as indicated by very poor performance during even the basic obedience training program. He was subsequently dropped from the experimental program.

A second dog posed difficulties for another reason. This dog was extremely gun shy and could not be depended upon to work under distracting influences. For example when working with a handler, the dog would begin crawling on the ground between the handler's legs if he heard a weapon fired at the rifle range as far as one-half mile away.

A third dog was the best trained of the five. However, he had to be eliminated from the program because of physical impairment (hip dysplasia), which would not permit him to work for a very long period of time.

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D-3

During the scouting training phase of the program, when dogs responded with a true alert to marked decoys the handler would take his dog in on the decoy and give the decoy about a 50-yard chase as a reward for the dog. The next step in the training program consisted of agitation with squalene on a rag to intensify the dog's alert response. After a couple of days of agitation with a rag, squalene was placed on a sleeve and the dogs were permitted to bite at the sleeve. One dog in the group undergoing training showed no interest in biting the sleeve; training for her consisted solely of agitation with the rag and chase of marked decoys.

In order to prevent routine training procedures and to remove bias by the handlers, occasionally all unmarked decoys were employed in scouting training. Only one dog (Benjie) responded with false alerts to unmarked decoy personnel. At first, handlers could not figure out why their dogs were not picking up alerts on decoys. They were subsequently informed by the instructor that none of the decoys had been marked. Throughout the remainder of the training program, the handlers did not know whether any of the decoys were marked, or which of the decoys were marked.

The next phase of the training consisted of lineup (identification) training. Initially, the dogs were not as interested in responding to lineup marked personnel as they had been in hidden decoys under scouting conditions. It took the dogs much longer to pick out marked personnel. However after three days of intensive training they were responding very well to the lineup training situation, with the exception of the gun-shy dog. In an effort to correct his gun shyness, simulated gun fire using M-80 firecrackers fired about 300 yards away were used, but it only made him worse.

About midway through the 18 weeks of intensive training, it was decided that no training would continue using marked objects or equipment, but that all training would be devoted to detection of personnel marked with squalene. During

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D-4

the later phases of this training program, the amount of squalene used to mark personnel was reduced at a programmed rate. The dogs responded with good accuracy until the inoculum was down to about 4 drops of 3 percent squalene. At this level they began to be much slower in picking up an alert response. Decoy scouting was mixed up with lineup identification sessions. When the inoculum was reduced to 4 drops of 1 percent squalene the dogs began to miss some of the marked personnel, so the inoculum was increased to 4 drops of 2 percent squalene and was used for the next four days of training. The inoculum was then returned to 4 drops of 1 percent squalene, and the dogs after the refresher training responded with 100 percent detection performance. Daily training sessions alternated between scouting training using hidden decoys and lineup identification training; the dogs almost always worked better at scouting detection problems. At the end of the 21 weeks' training period, the dogs were responding with 100 percent accuracy to an inoculum of 4 drops of 0.001 percent squalene. In summary, the dogs received intensive training between March and August, 1963, prior to beginning the Natick field studies. The Natick studies occurred between August and December, 1963. Two dogs, Buddha and Benjie, were then maintained in a partial state of preparedness at Fort Benning between December, 1963, and August 1965, when they were transported to Vietnam for the subject field experiments.

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APPENDIX E  
METEOROLOGICAL DATA

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TABLE E-1. (Continued)

Date	Daily Temperature, °F 0900	Relative Humidity, % 0900	Rainfall Past 24 hr, in.	Cloud Cover, Wind Direction, and Velocity (knots)
Oct. 25	--	--	0.91	--
26	107 (at 1500)	85 (at 1500)	Trace	At 1500 hours - clear, wind SW to NE, 0-2 k.
27	86	91	None	Clear, wind N to S, 0-2 k.
28	84	96	None	Clear, wind NE to SW, 0-2 k.
29	85	91	1.25	Cloudy, wind NW to SE, 0-3 k.
30	--	--	--	--
31	--	--	--	--
Nov. 1	--	--	--	--
2	--	--	--	--
3	--	--	--	--
4	--	--	--	--
5	82	87	None	Clear, wind NE to SW, 0-3 k.
6	84	87	None	Clear, wind N to S, 1-4 k.
7	--	--	--	--
8	87	88	Trace	Cloudy, wind W to E, 2-4 k.
9	84	83	0.23	Clear, wind NE to SW, 0-1 k.
10	84	91	--	Cloudy, wind N to S at (not measurable)
11	--	--	--	--
12	83	96	None	Clear, wind NE to SW, 0-3 k.
13	--	--	--	--
14	--	--	--	--
15	93 (at 1030)	77	None	Clear, wind variable, 0-1 k.
16	90	83	Trace	Clear, wind NW to SE, 0-1 k.
17	86	83	None	Clear, wind NE to SW, 0-2 k.
18	84	87	None	Clear, wind NE to SW, 0-3 k.
19	84	83	None	Clear, wind NE to SW, 0-3 k.
20	83	87	None	Clear, wind N to S, 0-3 k.
21	--	--	None	--
22	84	87	None	Clear, wind NE to SW, 0-3 k.
23	85	87	0.45	Clear, wind NE to SW, 0-2 k.

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E-2

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TABLE E-1. WEATHER OBSERVATIONS AT THANH TUY HA, VIETNAM,  
BETWEEN SEPTEMBER 26 AND DECEMBER 15, 1965<sup>(a)</sup>

Date	Daily Temperature, °F 0900	Relative Humidity, % 0900	Rainfall Past 24 hr, in.	Cloud Cover, Wind Direction, and Velocity (knots)
Sept. 26	--	--	2.95	--
27	82	87	Trace	--
28	87	80	0.41	--
29	78	96	0.45	Cloudy, S to N, 0 to 1 k.
30	--	--	None	--
Oct. 1	--	--	None	--
2	--	--	--	--
3	--	--	--	--
4	--	--	--	--
5	82	91	2.28	Clear, variable, 1 k.
6	84	91	1.36	Clear, NW to SE, 0-2 k.
7	83	91	None	Cloudy, S to N, 0-3 k.
8	84	92	None	Clear, wind variable, 0-1 k.
9	--	--	--	--
10	--	--	--	--
11	--	--	--	--
12	81	96	1.36	Cloudy, dead calm
13	84	91	None	Clear, wind W to E, 0-1 k.
14	79	96	0.23	Cloudy, wind NE to SW, 0-1/2 k.
15	79	91	0.57	Clear, wind NE to SW at 0-2 k.
16	--	--	--	--
17	--	--	--	--
18	--	--	--	--
19	80	91	--	Wind NE to SW, 0-1 k.
20	82	87	None	Clear, wind NE to SW, 1 k.
21	82	91	Trace	Overcast, wind NE to SW, 0-2 k.
22	82	91	0.34	Clear, wind NE to SW at 0-3 k.
23	--	--	--	--
24	--	--	--	--

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E-4

TABLE E-2. CUMULATIVE RAINFALL (INCHES) ON SQUALENE TEST PLOTS  
NOVEMBER AND DECEMBER, 1965

Test Plot No.:	1	2	3
Squalene Application Rate, lb/acre	7	14	14
Date Sprayed (Day 1)	November 15, 1965	November 17, 1965	November 22, 1965

Day	2	Trace	None	0.45
3		↓	↓	↓
4				
5				1.02
6				1.47
7			0.45	
8			↓	
9				
10			1.02	
11			1.47	
12				3.29
13				
14				
15				3.86
16				
17			3.29	
18			↓	
19				
20			3.86	
21				5.00
22			↓	
23				
24				
25				
26				
27			5.00	
28			↓	
29			5.45	
30				

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TABLE E-1. (Continued)

Date	Daily Temperature, °F 0900	Relative Humidity, % 0900	Rainfall Past 24 hr, in.	Cloud Cover, Wind Direction, and Velocity (knots)
Nov. 24	87	91	Trace	Cloudy, wind N to S, 0-1 k.
25	--	--	None	--
26	90	80	0.57	Clear, wind NE to SW, 1-3 k.
27	81	87	0.45	Cloudy, wind NW to SE, 1-4 k.
28	--	--	None	--
29	84	87	Trace	Clear, wind NE to SW, 0-2 k.
30	--	--	None	--
Dec. 1	--	--	--	--
2	87	76	None	Clear, wind NE to SW, 0-3 k.
3	80	91	1.82	Clear, wind NE to SW, 0-3 k.
4	82	83	None	Clear, wind NE to SW, 0-3 k.
5	--	--	None	--
6	83	83	0.57	Clear, wind E to W, 1-3 k.
7	79	83	None	Clear, wind NE to SW, 1-4 k.
8	82	83	None	Clear, wind NE to SW, 1-4 k.
9	84	79	None	Clear, wind NE to SW, 0-1 k.
10	84	83	None	Cloudy, wind NE to SW, 0-3 k.
11	--	--	None	Clear, weather gear locked up in Pharmacy
12	--	--	None	--
13	80	83	1.14	Clear, wind NE to SW, 1-5 k.
14	85	83	None	Clear, wind NE to SW, 1-4 k.
15	81	83	0.45	Clear, wind NE to SW, 0-1 k.

(a) Dashes (--) indicate that no measurement was recorded.

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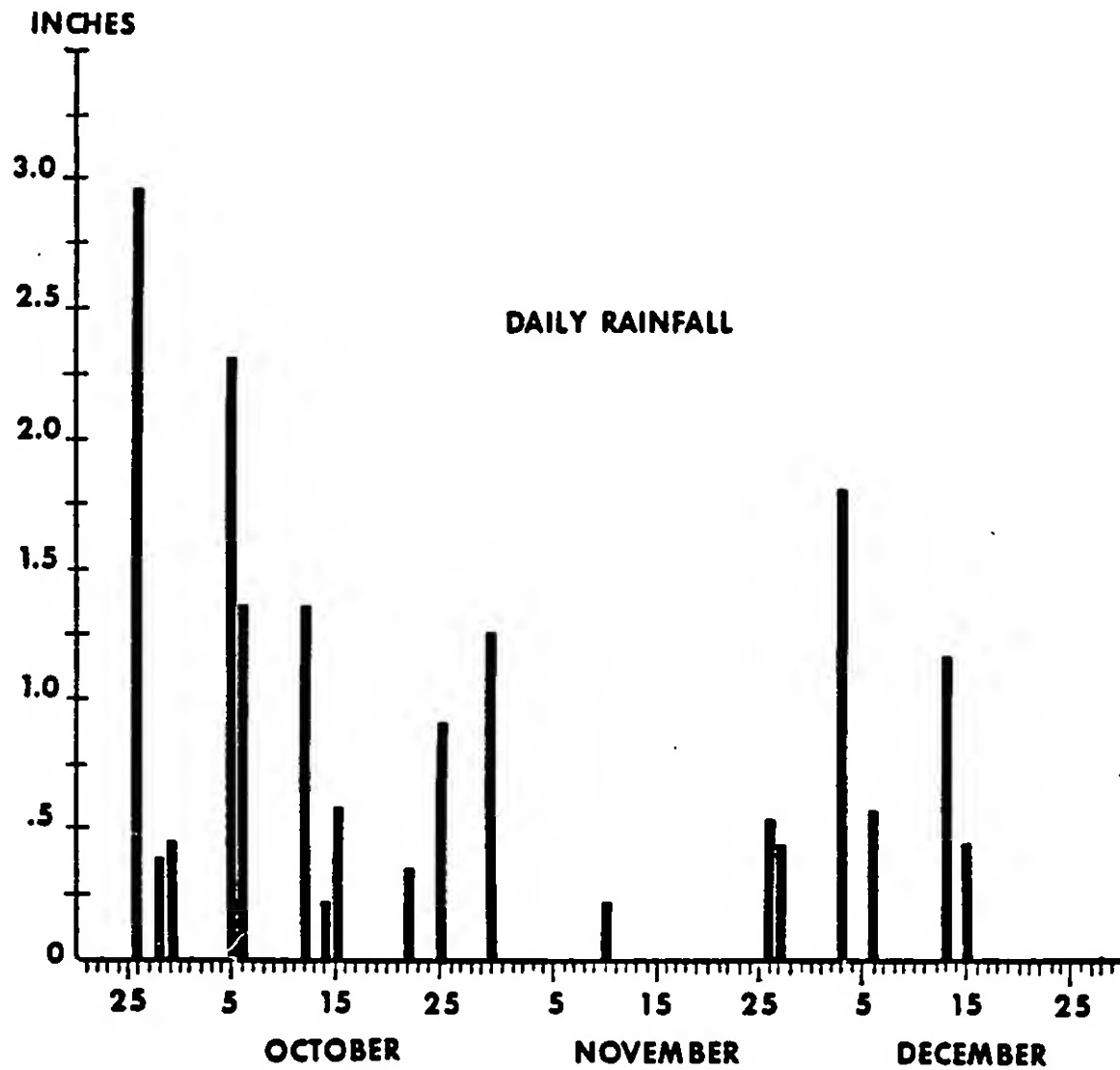
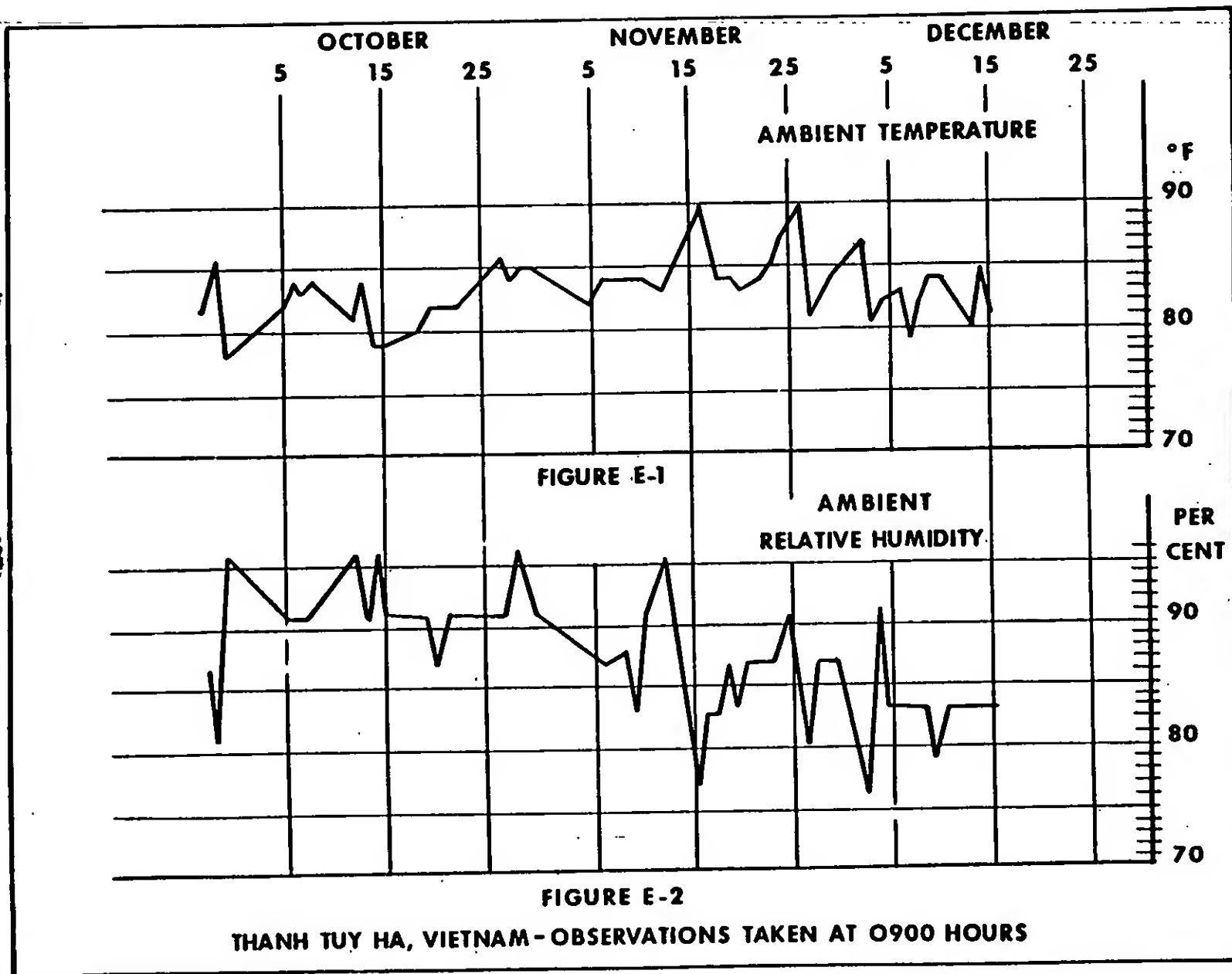


FIGURE E-3  
THANH TUY HA, VIETNAM -  
RECORDED DAILY AT 0730 HOURS

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APPENDIX F

RECOMMENDED TRAINING PROGRAM FOR DOGS TO BE USED  
IN DETECTION OF PERSONNEL MARKED WITH SQUALENE

This appendix outlines in some detail a recommended training program to be used in preparing scout dogs to respond to the man-squalene odor. In large measure, it represents the expert opinion of Sgt. Robert D. Bennett, U. S. Army, who has been actively engaged in military scout-dog programs as a handler and trainer since 1948. The authors of this report acknowledge the assistance and professional guidance rendered by Sgt. Bennett both in the conduct of the field experiments in Vietnam and subsequent debriefing sessions held at Battelle during January, 1966.

The recommended dog-training program consists of five steps and covers a time interval of 16 weeks, including three weeks of overseas in-country refresher training. The five steps are these:

- (1) Two weeks of basic obedience training
- (2) One week of scouting training against personnel marked with squalene
- (3) Three weeks of scouting training, with only a percentage of the personnel marked with squalene (female as well as male personnel should be included among the test subjects)
- (4) Seven weeks of lineup, scouting, checkpoint, and crowd training with both marked and unmarked personnel
- (5) Three weeks of similar training in the country in which the dogs are to be used.

The initial two weeks of basic obedience training [Step (1)] should be conducted in accordance with the provisions of Army Field Manual 20-20, and need no further clarification in this report. With reference to the one week of initial scouting training on personnel marked with squalene [Step (2)], the

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APPENDIX F

RECOMMENDED TRAINING PROGRAM FOR DOGS TO BE USED  
IN DETECTION OF PERSONNEL MARKED WITH SQUALENE

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in unmarked personnel. When they alert correctly on marked personnel they will be given a short chase as a reward. This will be repeated many times until the dogs will only alert on marked personnel. Again, marked personnel should not always be the same individuals, so the dogs will not become familiar with them. Because of the amount of correction that will have to be given to the dogs during this phase of the training, dogs should also receive more agitation and chase to maintain or increase their interest in their training program. Beginning with this phase of the training program it is also necessary to adjust the dogs to working under conditions of distracting influences. No special effort should be observed to minimize such distractions as the presence of people, discharge of firearms, presence or movement of other animals, etc. In fact, it would be wise to purposely create distracting influences on random occasions.

The next phase of the training program consists of some seven weeks of identification (lineup) training [Step (4)]. During this phase, the dogs will be trained to detect and respond to marked personnel mixed with unmarked personnel in random order, with the personnel being in a single rank. In addition, the dogs should be trained to respond to increasingly smaller amounts of squalene as the marking material. The amount of squalene applied to a test subject should be decreased each day, beginning with fairly large amounts (in the order of 4 to 10 mg). It can be expected that some dogs will stop responding to the man-squalene odor when the dosage of squalene gets below a certain level. In this case, these dogs should be presented with the last recognized level for two more days and then continue with the next lower level of squalene.

During this same phase, the dogs should be introduced into checkpoint training. Test personnel, some of whom are marked with squalene, will be walked through a simulated checkpoint with the dog and handler in a downwind position.

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following remarks describe the training situation. During the first week of scouting training the dogs will be working with marked personnel only. The decoy (marked person) will be placed about 25 to 30 yards upwind from the dog. The dog will be worked downwind from the decoy, and will approach to within a distance of 8 to 10 yards. As soon as the dog shows any sign of alerting, the handler will talk to the dog and take him in on the marked decoy person. When the dog and handler get to within 4 to 5 yards from the decoy, the decoy will get up and run, with the dog and handler in pursuit. The chase feature of the program reinforces the dog with the man-squalene scent characteristic. This scouting training will be repeated as many times as deemed necessary, with occasional intervals of basic obedience training. Throughout the 16 weeks of intensive training it is assumed that the major portion of each day will be consumed in such training as opposed to 1 to 2 hours per day. When the dogs begin to react strongly on such short patrol exercises, the exercise will be lengthened. The decoy will be given a rolled-up sack with squalene on it to agitate the dog by striking at him. Later the dog will be given a sleeve with squalene on it to bite when agitated. The same personnel should not be used repeatedly as decoys, but should be rotated from within a larger group. This is to prevent the possibility of dogs responding only to a specific man odor. Also, dogs in training who are weak responders and do not improve with agitation should be placed in a circle with dogs giving more positive responses. An agitator in the center of the circle will be marked with squalene (see Army Field Manual 20-20). The more vigorous response of the well-trained dogs should reinforce the weaker dogs and build up their response.

During the next three weeks of scouting training [Step (3)], dogs will be used to respond against groups of individuals including both marked and unmarked personnel. The dogs will be corrected whenever they show any interest

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type of training. The handler will have to watch closely for an alert response and try to teach the dog to respond from a short distance. Occasionally, none of the people simulating the crowd should be marked. If the dog always finds someone who is marked, he may tend to give a false alert when presented with an unmarked group unless trained to do otherwise. Such crowd identification training should be included and mixed daily with lineup identification and checkpoint training. On some occasions, civilian clothing should be worn by test subjects.

Test subjects in a lineup identification training session should be in a single rank at intervals of about 12 to 15 feet; the dogs should always be worked on the downwind side. Some of the persons in the lineup should move (at first only unmarked personnel) so as to attempt to distract the dog. If the dog responds to an unmarked person because of that movement, the dog should be corrected. Every effort should be made to train the dogs to respond only to the squalene-man scent. During lineup identification training, dogs should on occasion be presented with lineups in which no individuals are marked. In addition, the handlers should not know when marked personnel are present in a lineup and/or who is marked when they are present; this procedure should be used after an initial two weeks of lineup identification training. Rather, the instructor should tell the handler if the dog has alerted incorrectly and on-the-spot correction should be applied. This routine should be used for all subsequent training. At the completion of the above-described 13 weeks of intensive training, the handler should be thoroughly familiar with his individual dog and should be able to interpret the true alert response of the dog almost without exception.

This 13-week training program will be conducted in the Continental United States. The following recommendations apply to a final three-week training

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They will pass the checkpoint at intervals of 5 to 7 feet. During the first few days of this training, it can be expected that it will be difficult for the dog handlers to properly interpret the response of their dogs, until the dog becomes accustomed to having people walk by him. The handler will have to watch his dog very carefully to know when the dog has picked out and responded to a marked person. When test personnel are moving toward the dog, the dog will react differently than when the test personnel are standing in a rank, or just milling about randomly. Such training should be worked into the training program daily, along with lineup identification training. The test subjects should not always come through the checkpoint at fixed intervals in a single file, but should be mixed up occasionally so that the dog can sometimes see only one person walking toward him at a time and sometimes a line of several people going through at various intervals. It is most important that the dog not become accustomed to any set pattern or routine. It will also improve the handler's ability to correctly interpret the true alert response from his dog. Consideration can be given to the design and use of a special muzzle (since the dog will be working in close contact with personnel). However, it will be most important that any such muzzle be designed so that the nose end of the muzzle is completely open.

After one week's training in the use of lineup identification and checkpoint identification procedures, the dog should be introduced into identification of individuals among groups of personnel. A group of 10 to 30 test subjects, some of whom are marked, should represent or simulate a crowd such as may be found in a market area. Some of the test subjects should be female. The dog handler will have to exercise extreme caution so that no one is accidentally bitten during this phase of the training. A short leash (approximately 2 feet long) should be used. The dog will have a tendency to place his nose against personnel in this

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<p>(C) This report discusses the field experiments developed to determine the feasibility of using the squalene marking system in tactical counterinsurgency operations under conditions such as exist in Vietnam, more specifically, the feasibility of using dogs to detect terrain and personnel marked with squalene. The major objectives were (1) to investigate under controlled conditions the persistence of squalene when applied to selected terrain in the environment of Southeast Asia, and (2) to investigate under controlled conditions the persistence of squalene on indigenous personnel in the environment of Southeast Asia. The experiments were conducted under the control of the Advanced Research Projects Agency, Research and Development Field Unit, Vietnam, in cooperation with the Army of the Republic of Vietnam and the Vietnamese Combat Development Test Center.</p>			

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period which will be conducted in the foreign country in which the dogs and handlers are to be used [Step (5)]. In order to maintain the proficiency of the dogs and handlers, the same group instructor should be used, and no change of handlers should be permitted during the entire training program. In in-country training programs, indigenous personnel should be used as the training test subjects. Probably the most important requirement is for a thoroughly capable interpreter to be assigned to the instructor so that the test subjects can be thoroughly briefed on how they are to conduct themselves during the training phases. As in the U. S., each daily training session should occupy the full normal work day during this three weeks of in-country training.

Upon completion of the refresher training, when the dogs go operational, they should routinely be exposed to retraining for at least 2 hours each week, regardless of their operational employment. In addition, whenever there is a change of handlers, the new handler should be given at least six weeks of daily full-time training with the dog before again attempting operational situations. It is extremely important that the handler be thoroughly familiar with the working responses of his particularly assigned dog. Throughout the entire training program, the physical fitness of both the dog and the handler should be emphasized. The dogs particularly must be maintained in top physical condition; during the process of responding to a positive alert the dog is straining at the leash and becomes physically exhausted after only a few alerts if not in sound physical condition.

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(U) THE USE OF A MARKING  
AGENT FOR IDENTIFICATION BY DOGS

Report No. BAT-171-40

March 11, 1966

Prepared for

Advanced Research Projects Agency

Project AGILE

Contract No. SD-171  
ARPA Order No. 324

By

A. C. Peters and W. H. Allton, Jr.

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Any comments or suggestions you may have in regard to this study will  
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Sincerely,

*John W. Murdock*

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